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(54) **MEDICAMENT DELIVERY DEVICES FOR ADMINISTRATION OF A MEDICAMENT WITHIN A PREFILLED SYRINGE**

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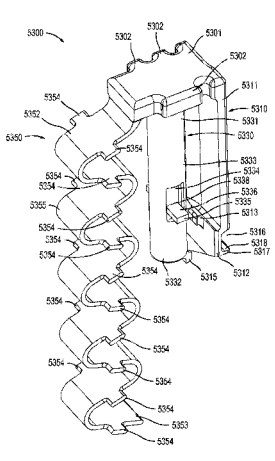
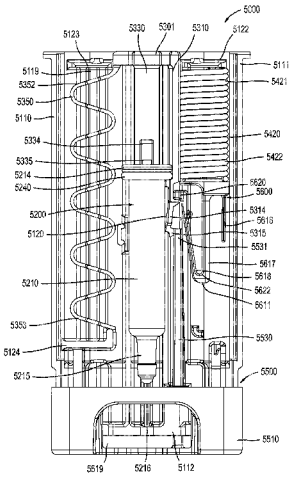
(57) **ABSTRACT**

An apparatus includes a housing, a medicament container and a movable member. The medicament container is configured to move within the housing between a first position and a second position in response to a force produced by an energy storage member. A proximal end portion of the medicament container includes a flange and has a plunger disposed therein. A first shoulder of the movable member is configured to exert the force on the flange to move the medicament container from the first position to the second position. A portion of the first shoulder deforms when the medicament container is in the second position such that at least a portion of the force is exerted upon the plunger. A second shoulder of the movable member is configured to exert a retraction force on the flange to move the medicament container from the second position towards the first position.

36 Claims, 90 Drawing Sheets





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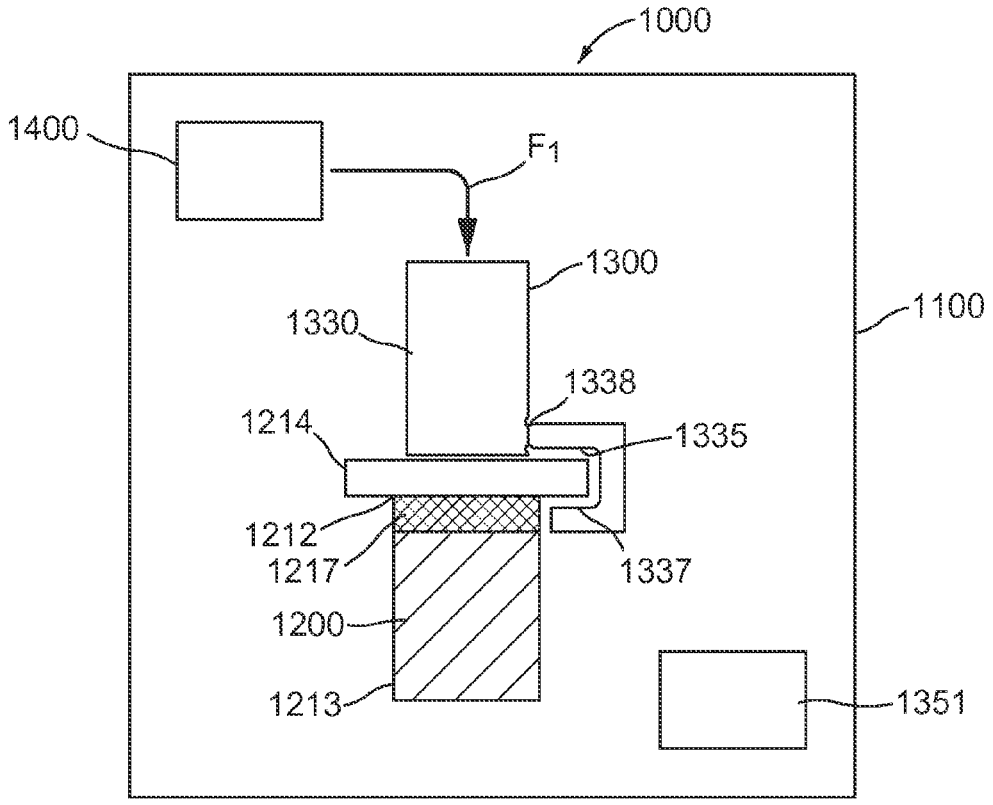
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FIG.1

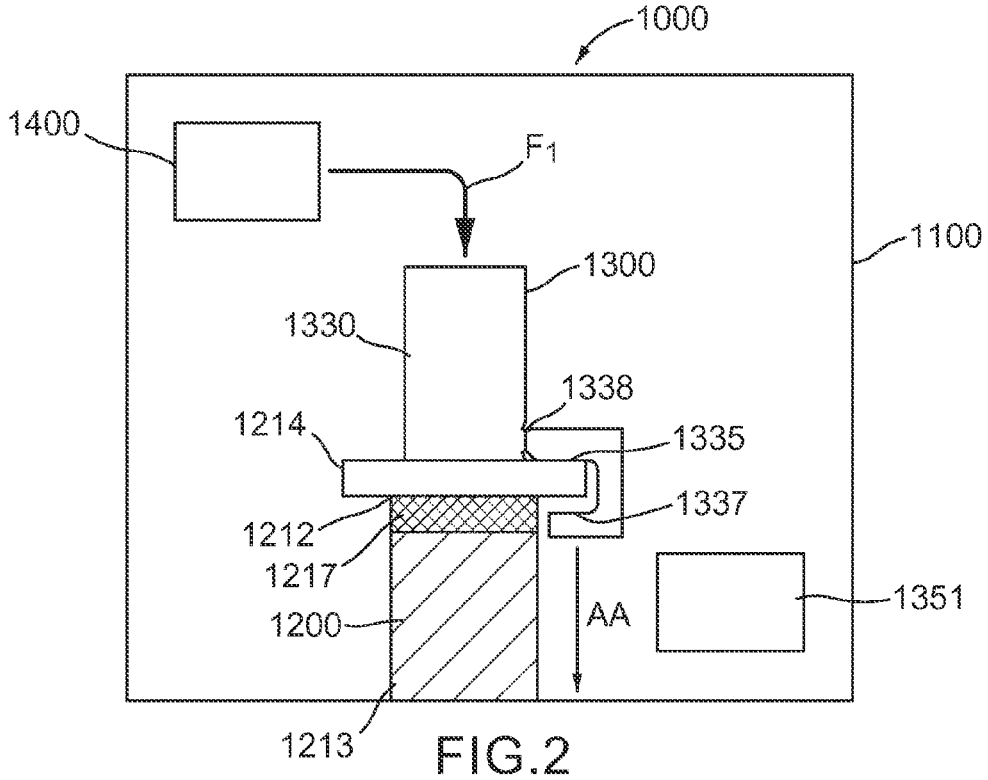
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FIG.2

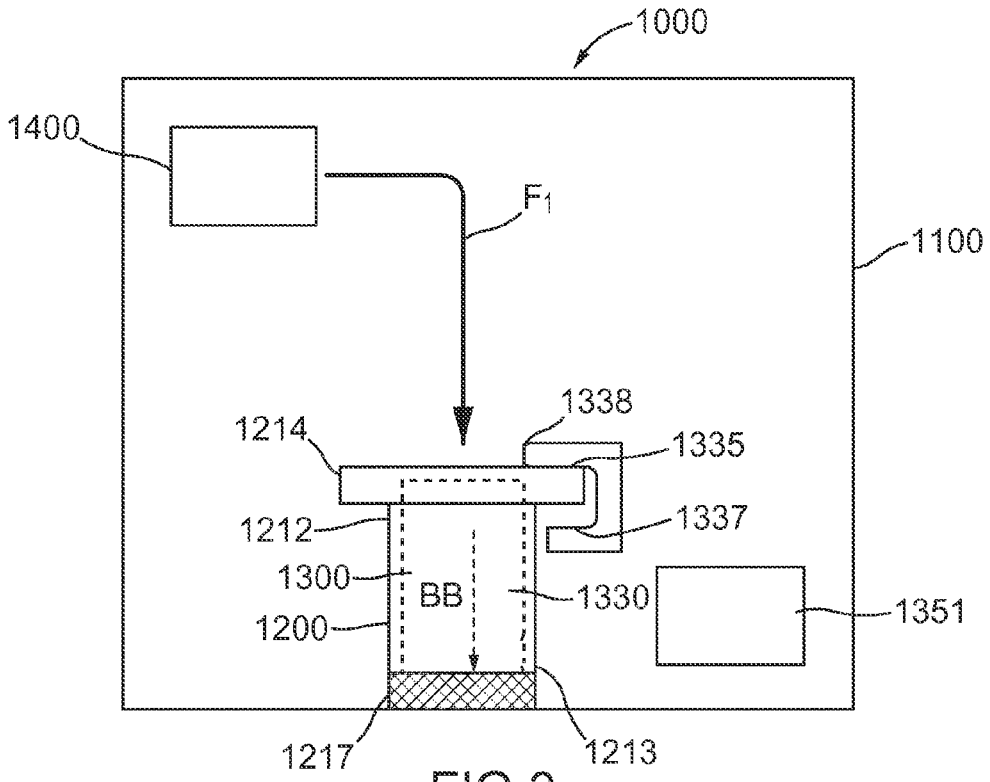
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FIG.3

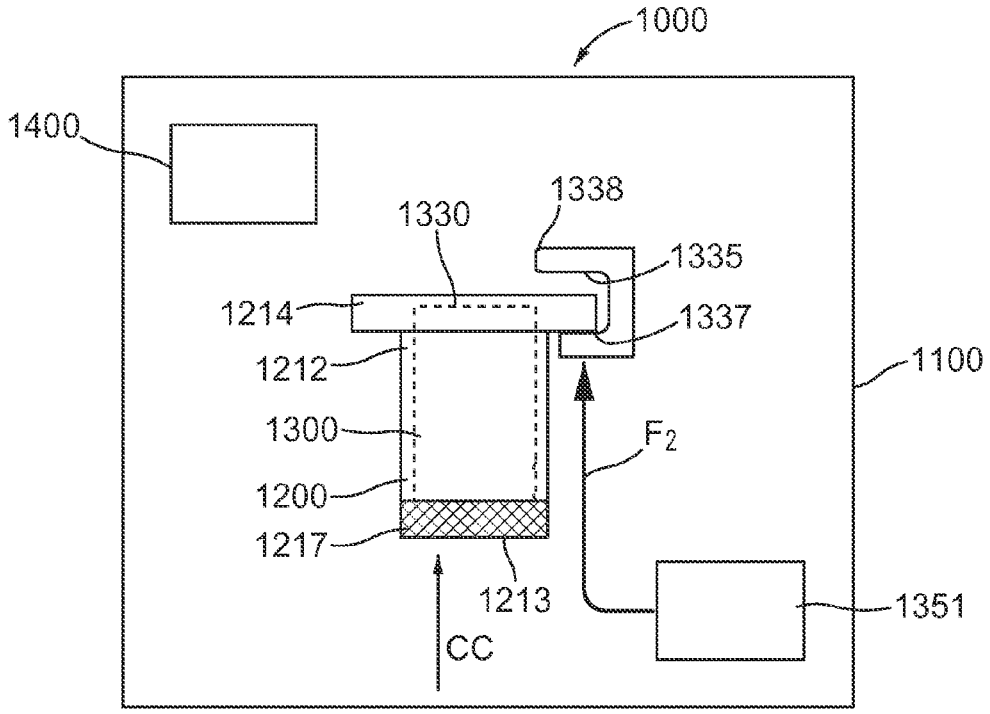
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FIG.4

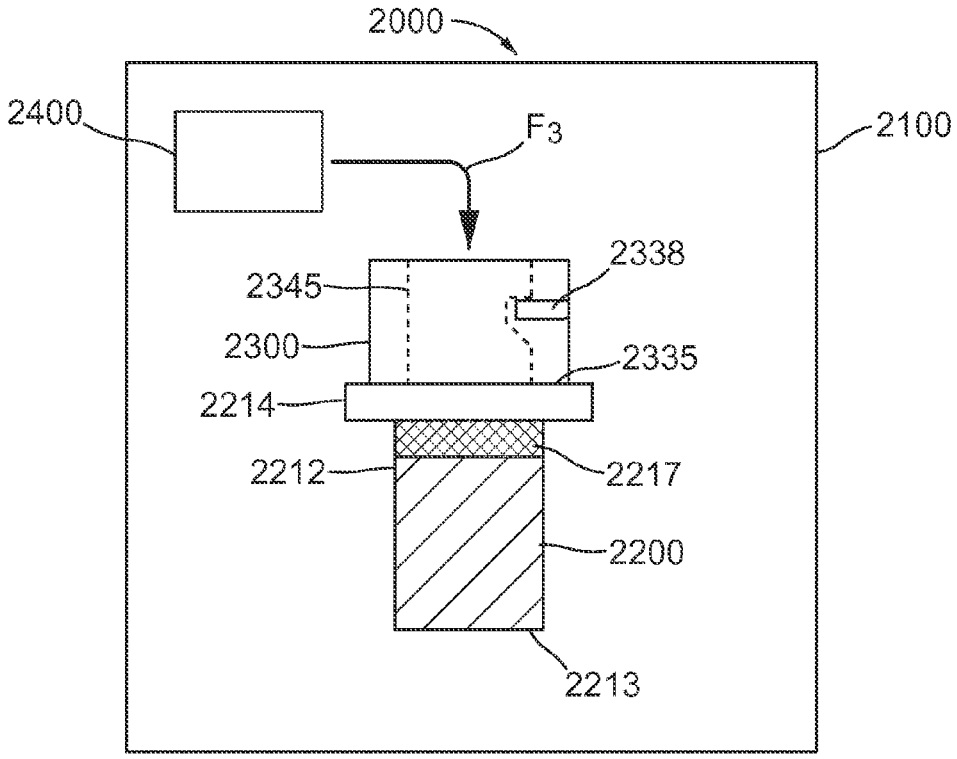
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FIG.5

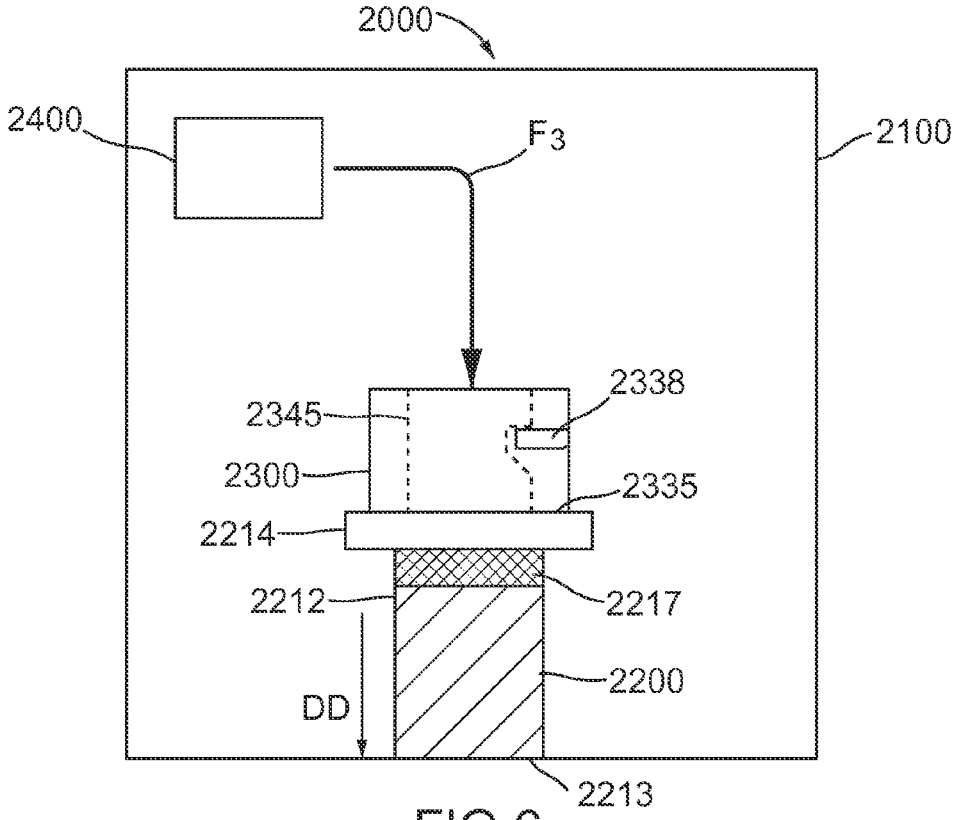
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FIG.6

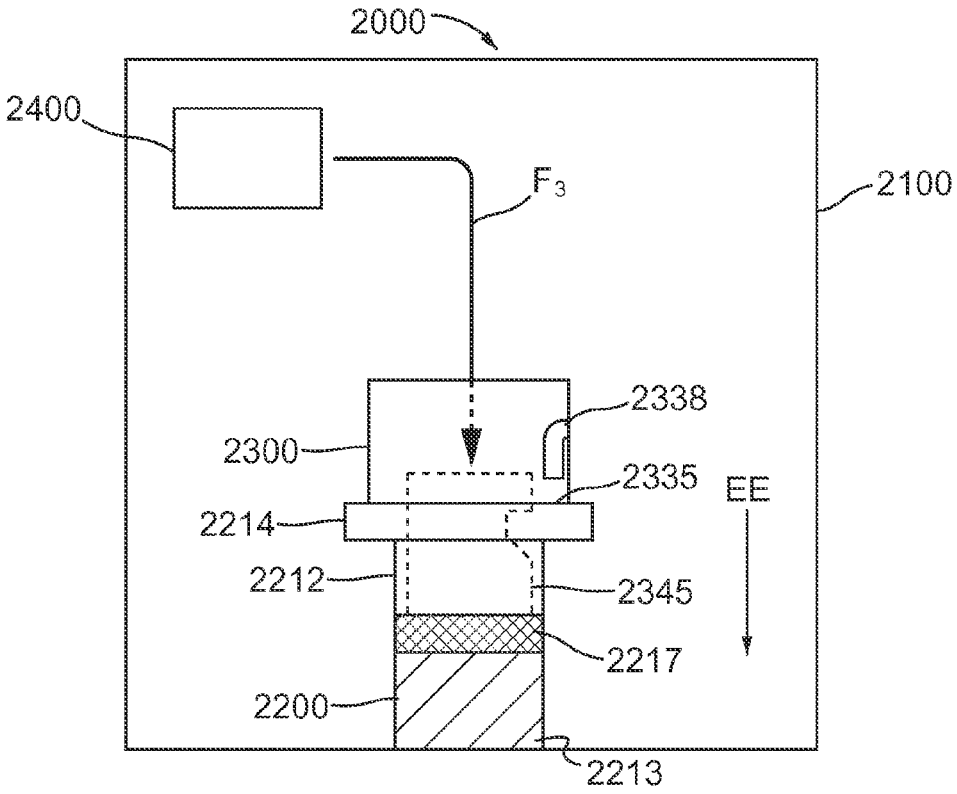
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FIG.7

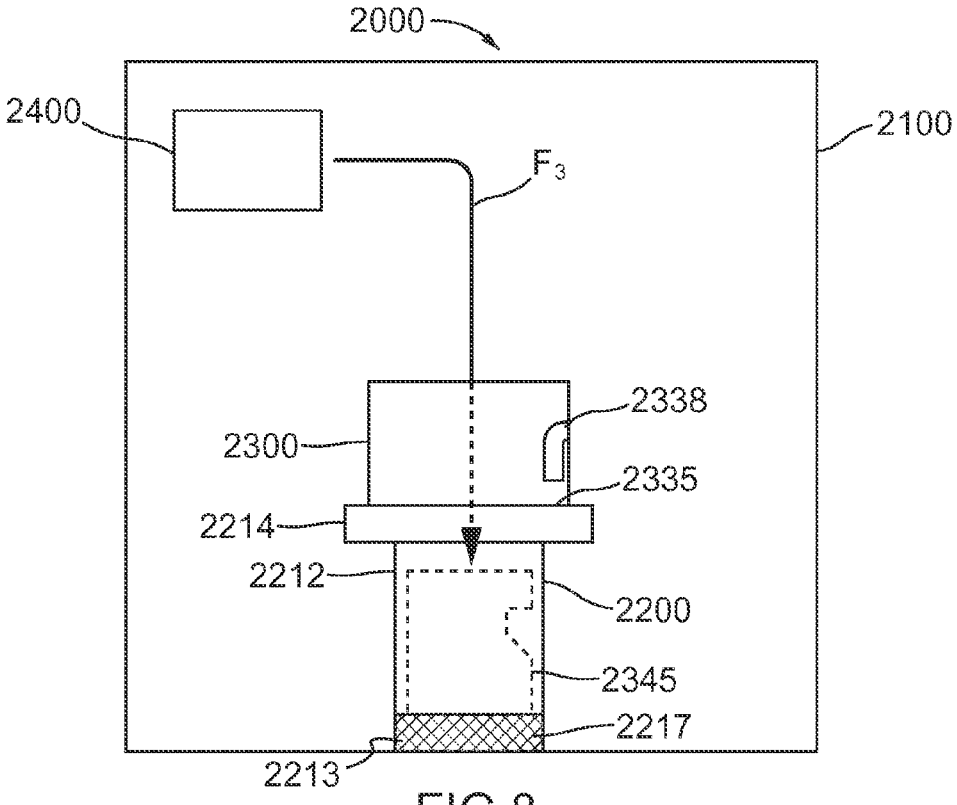
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FIG.8

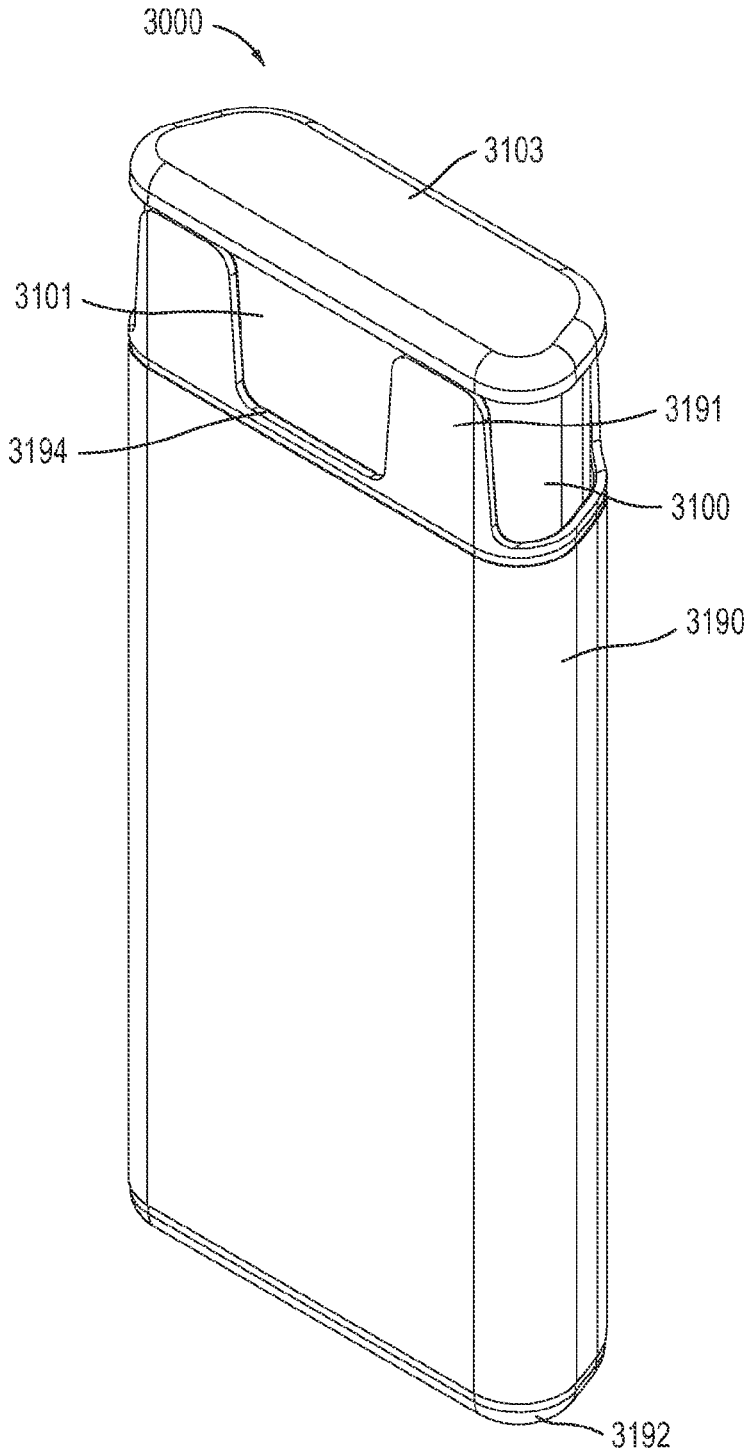

FIG.9

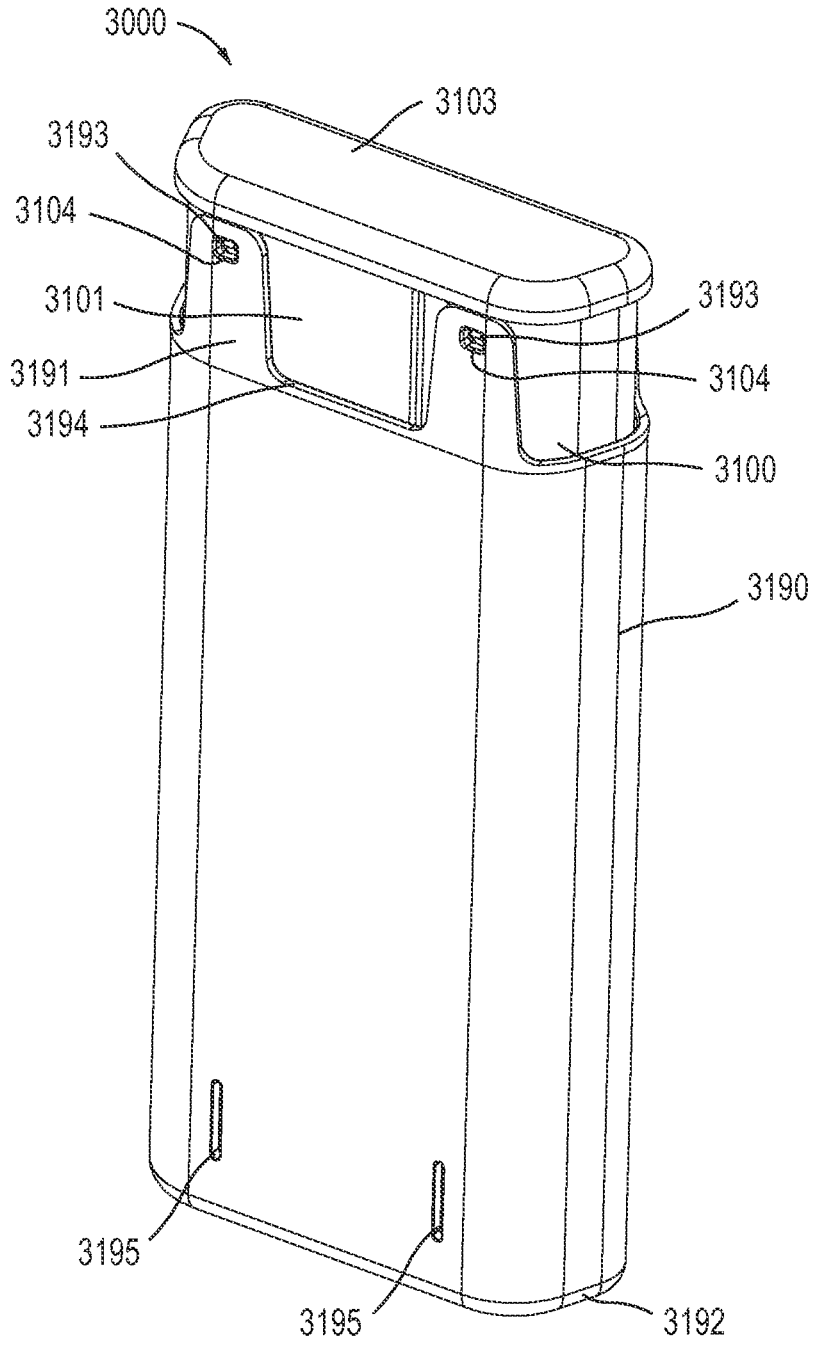
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FIG.10

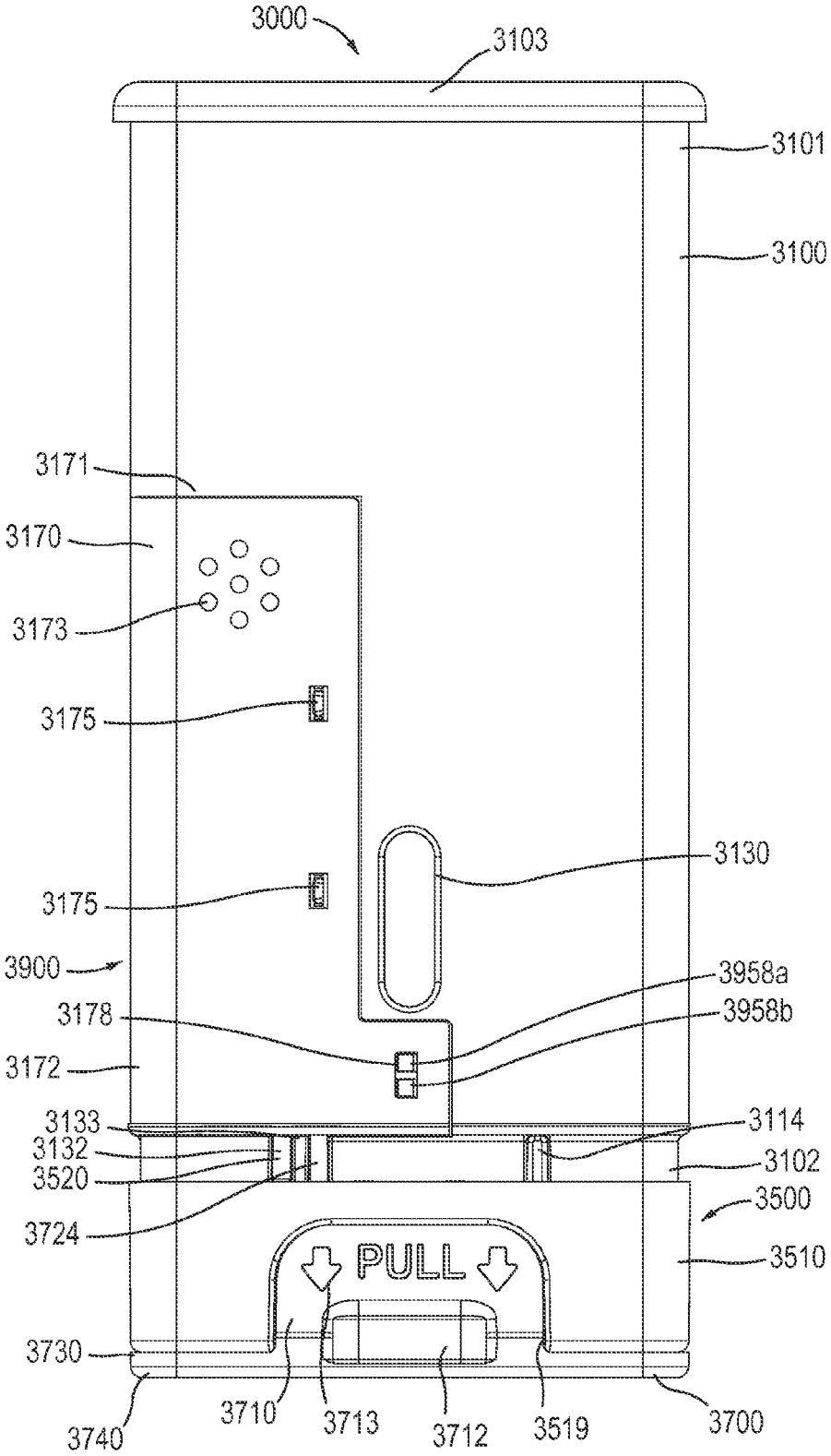
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FIG.11

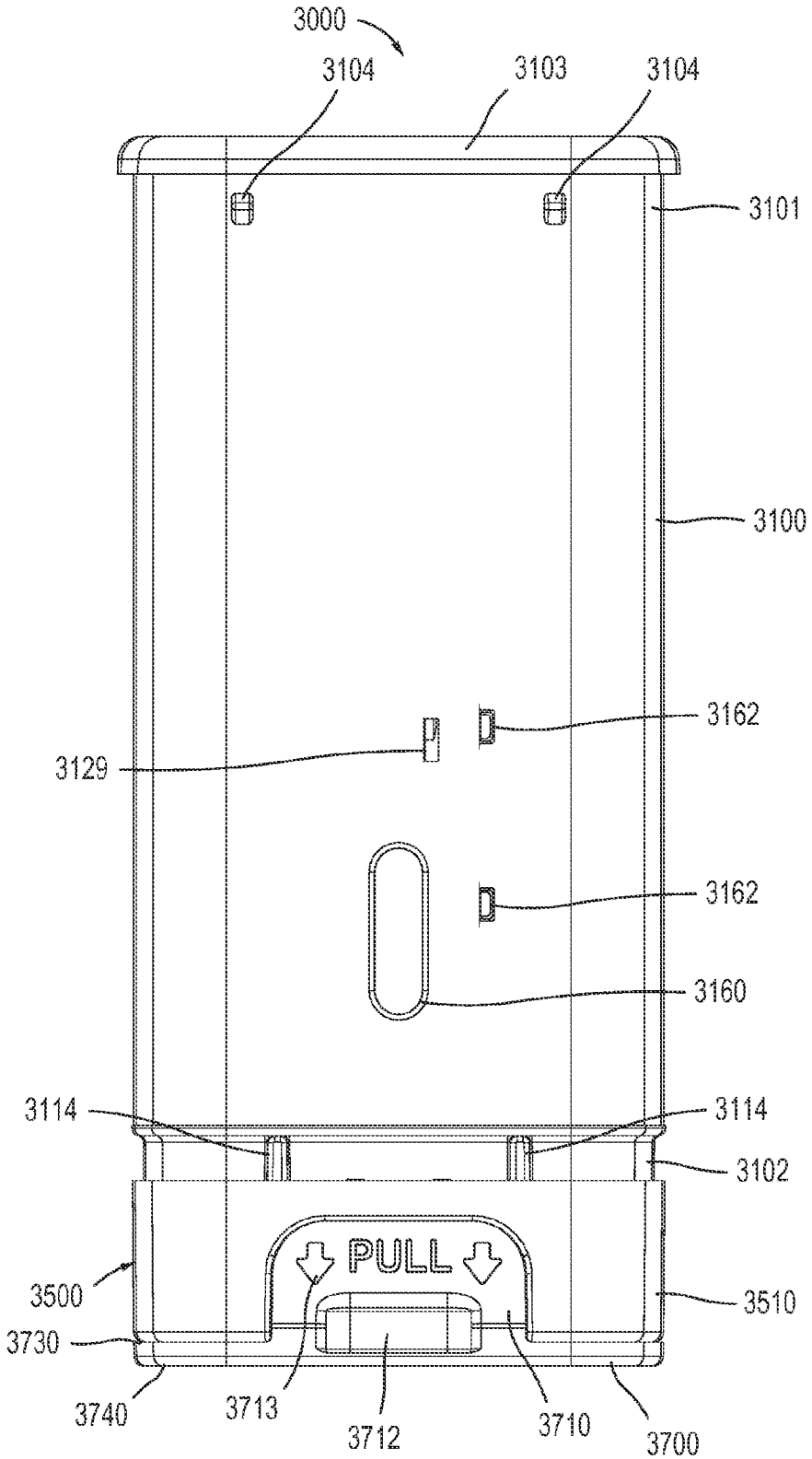
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FIG.12

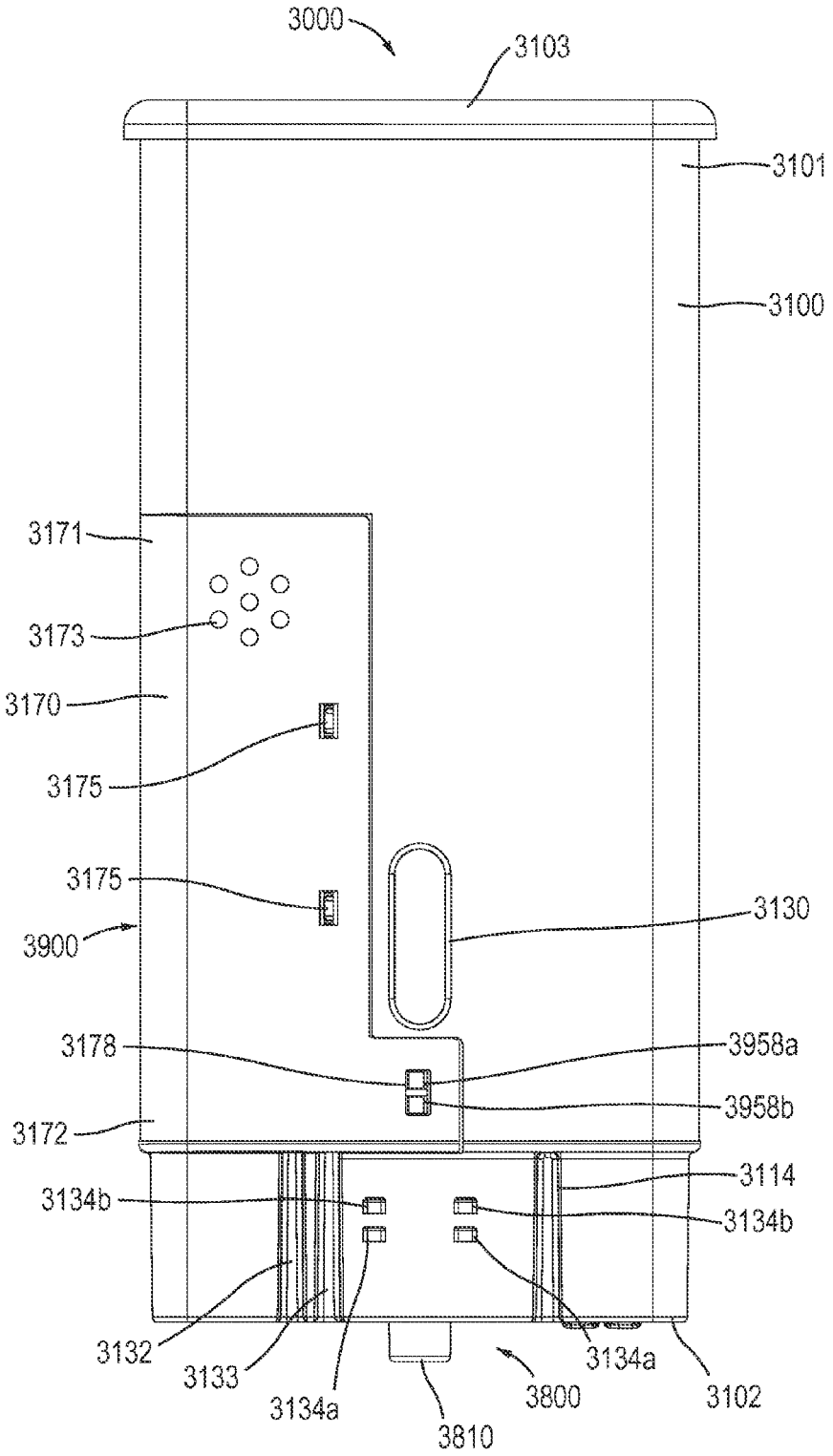
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FIG.13

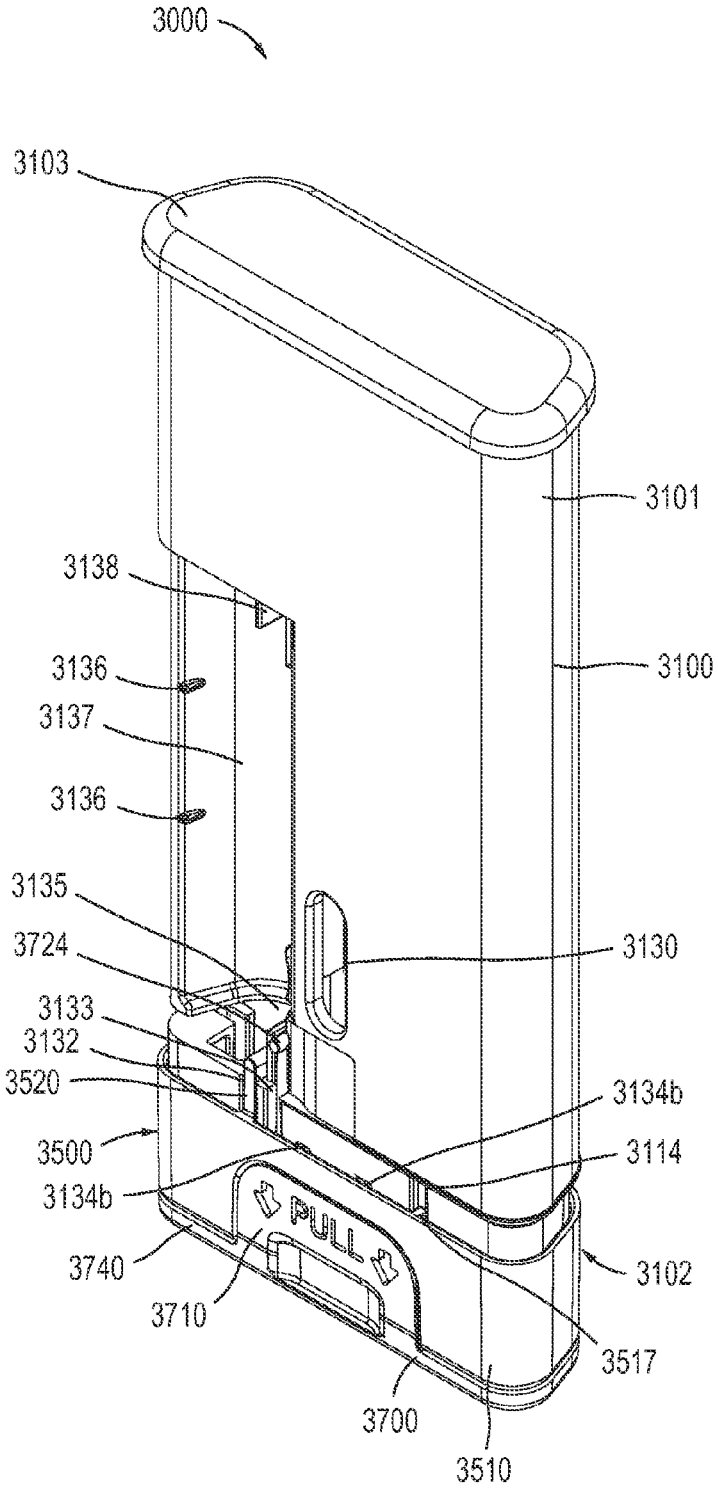
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FIG.14

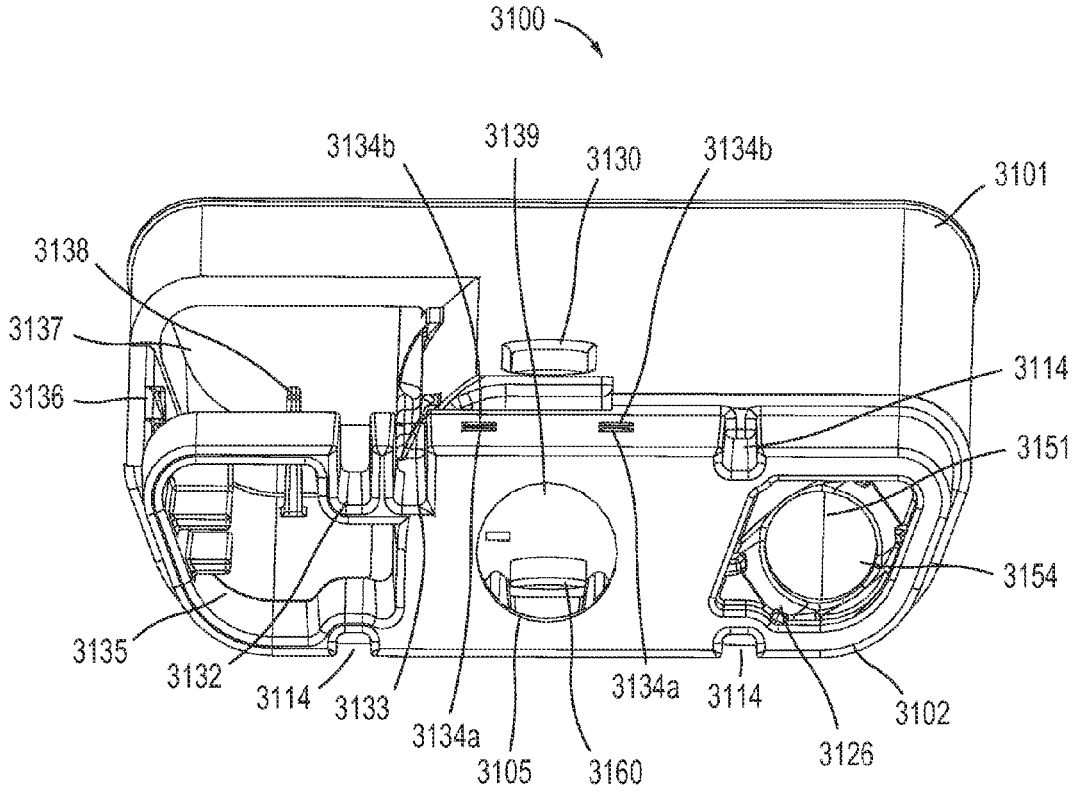
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FIG.15

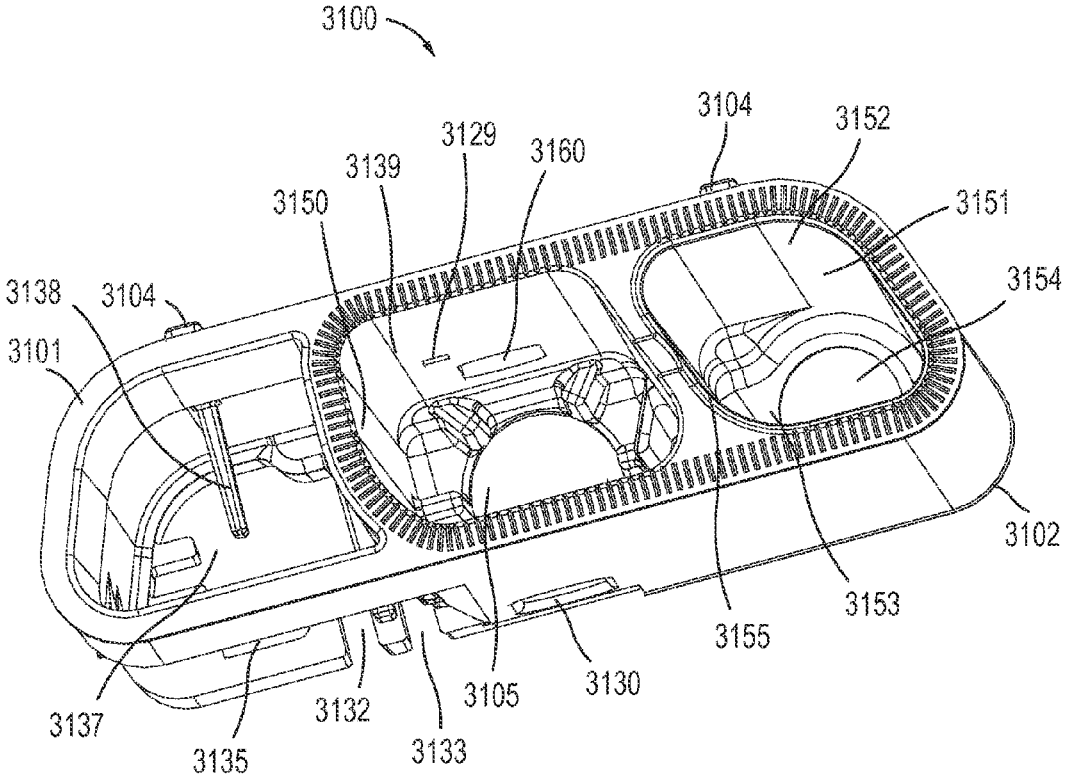
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FIG.16

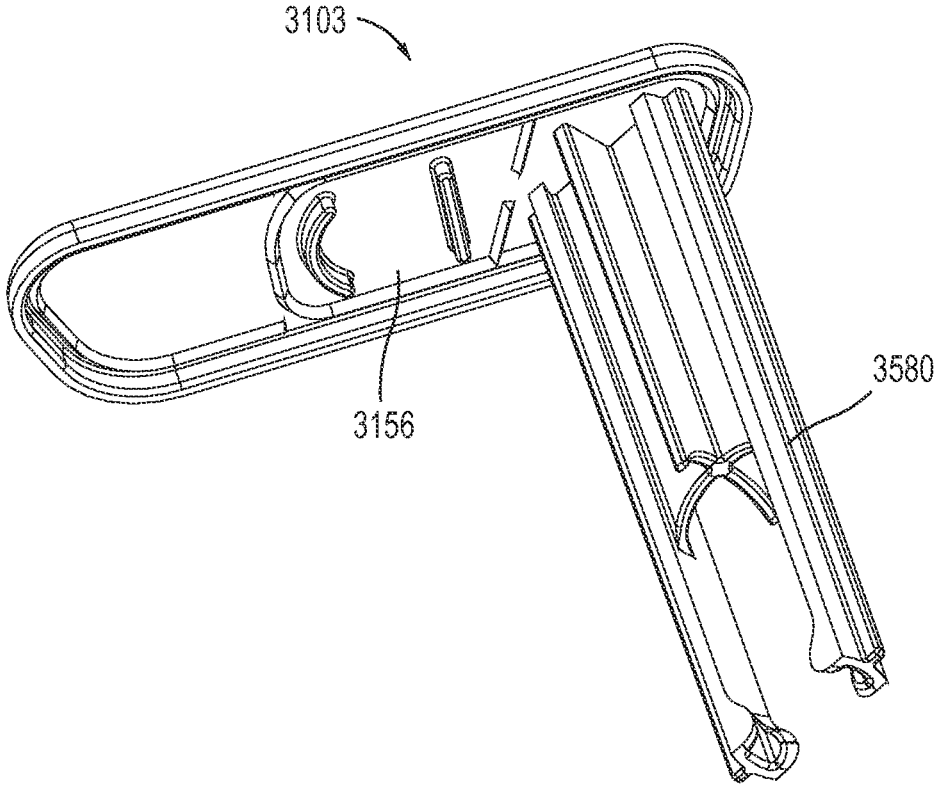

FIG.17

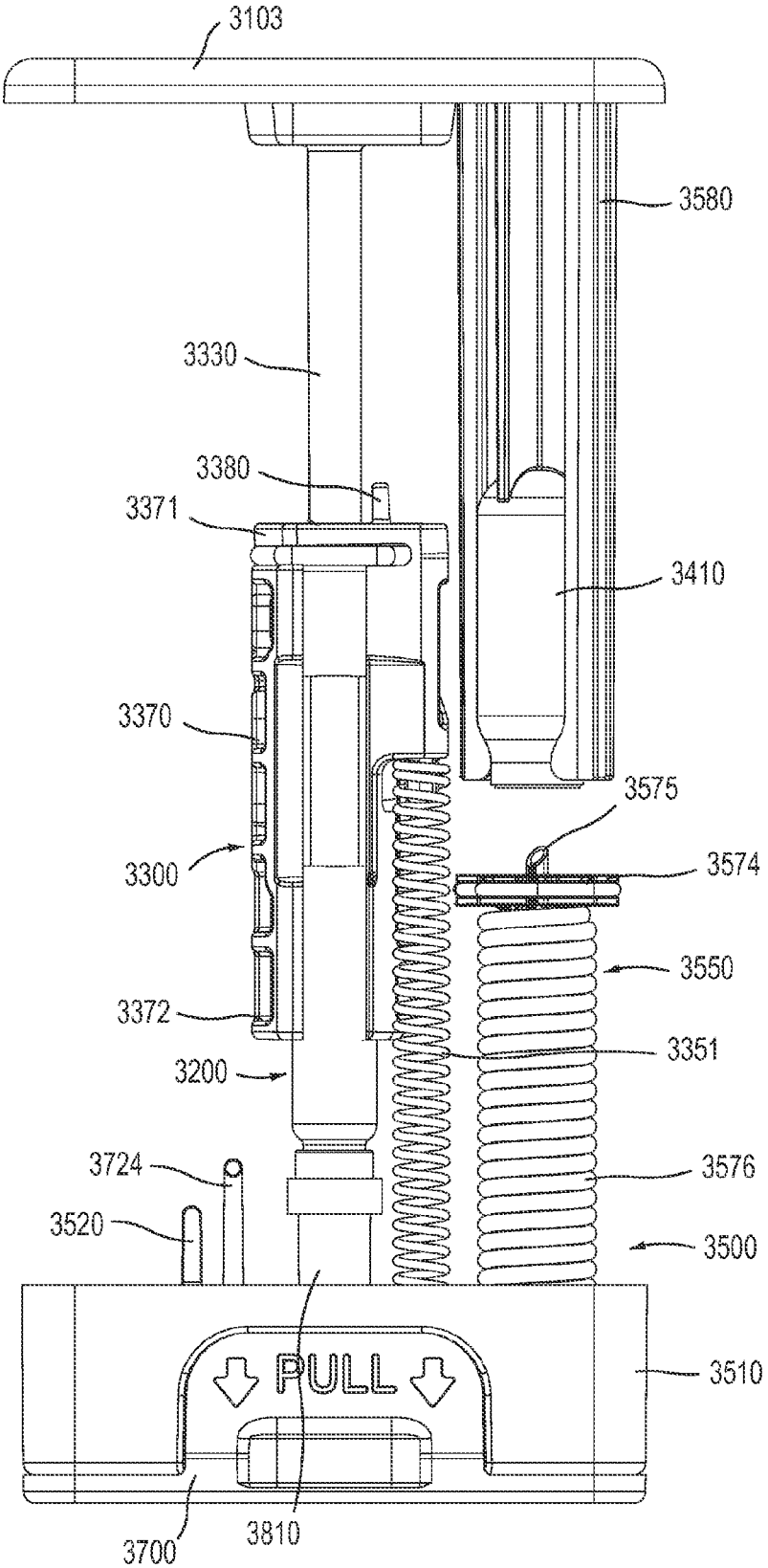
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FIG.18

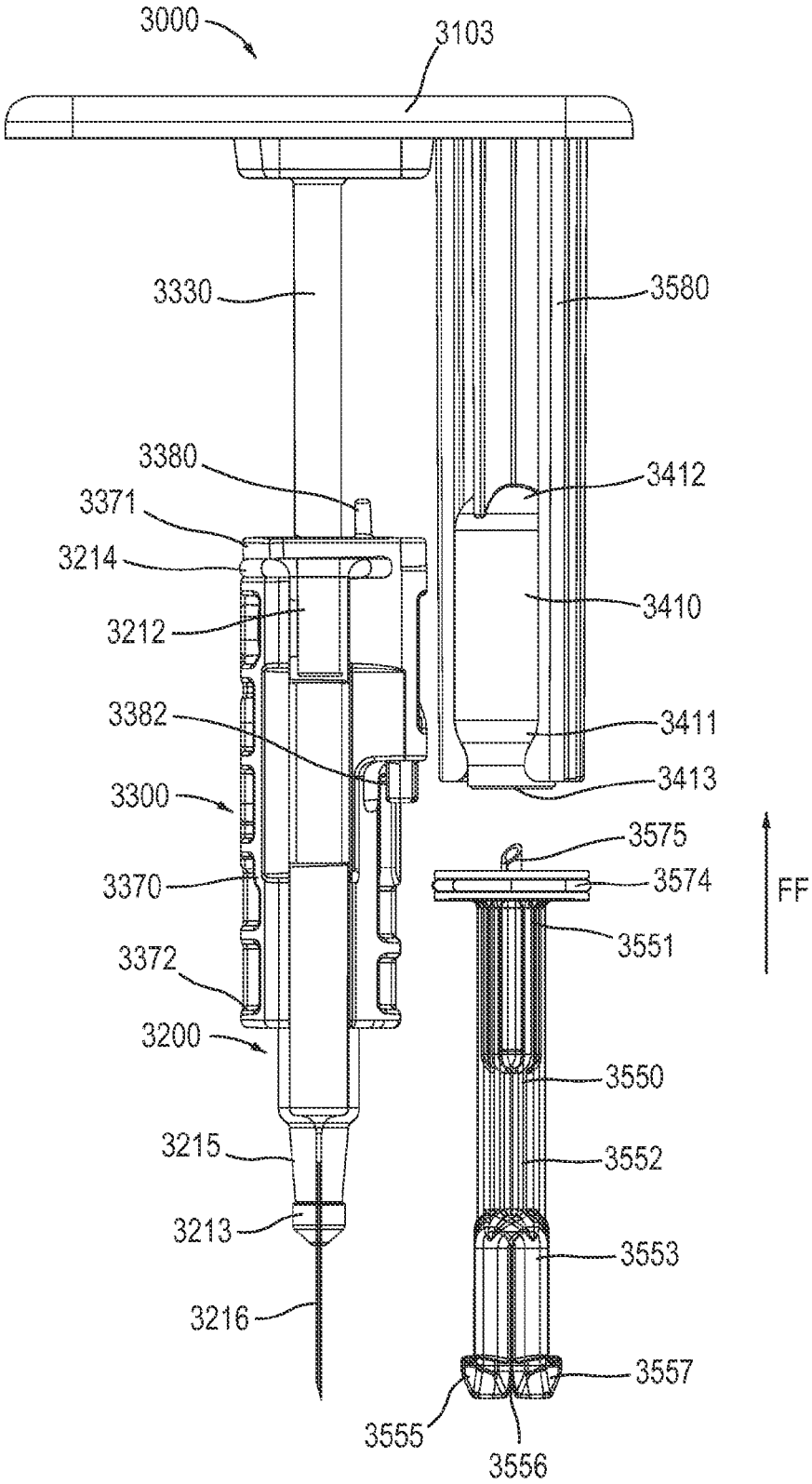
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FIG.19

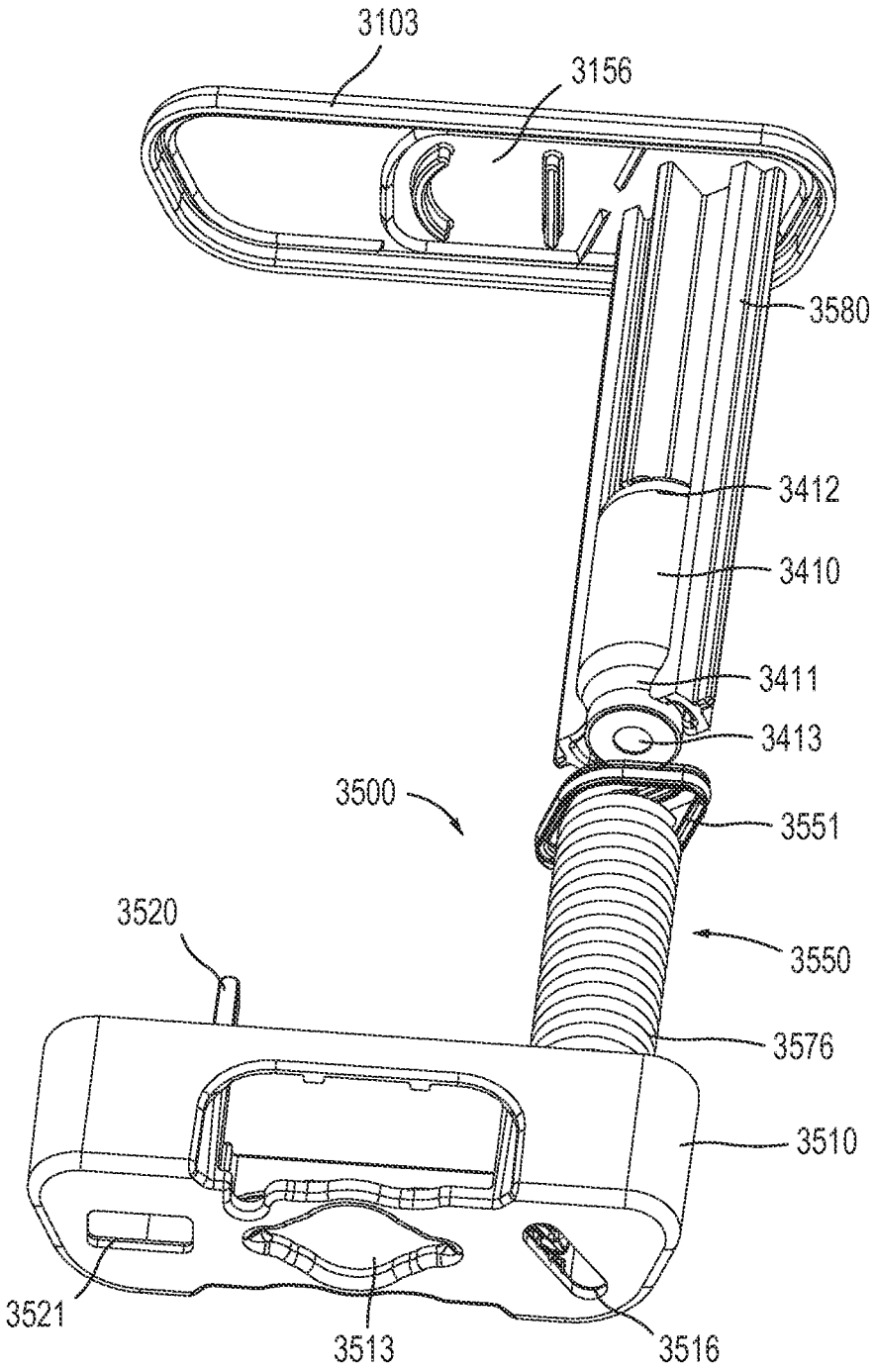
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FIG.20

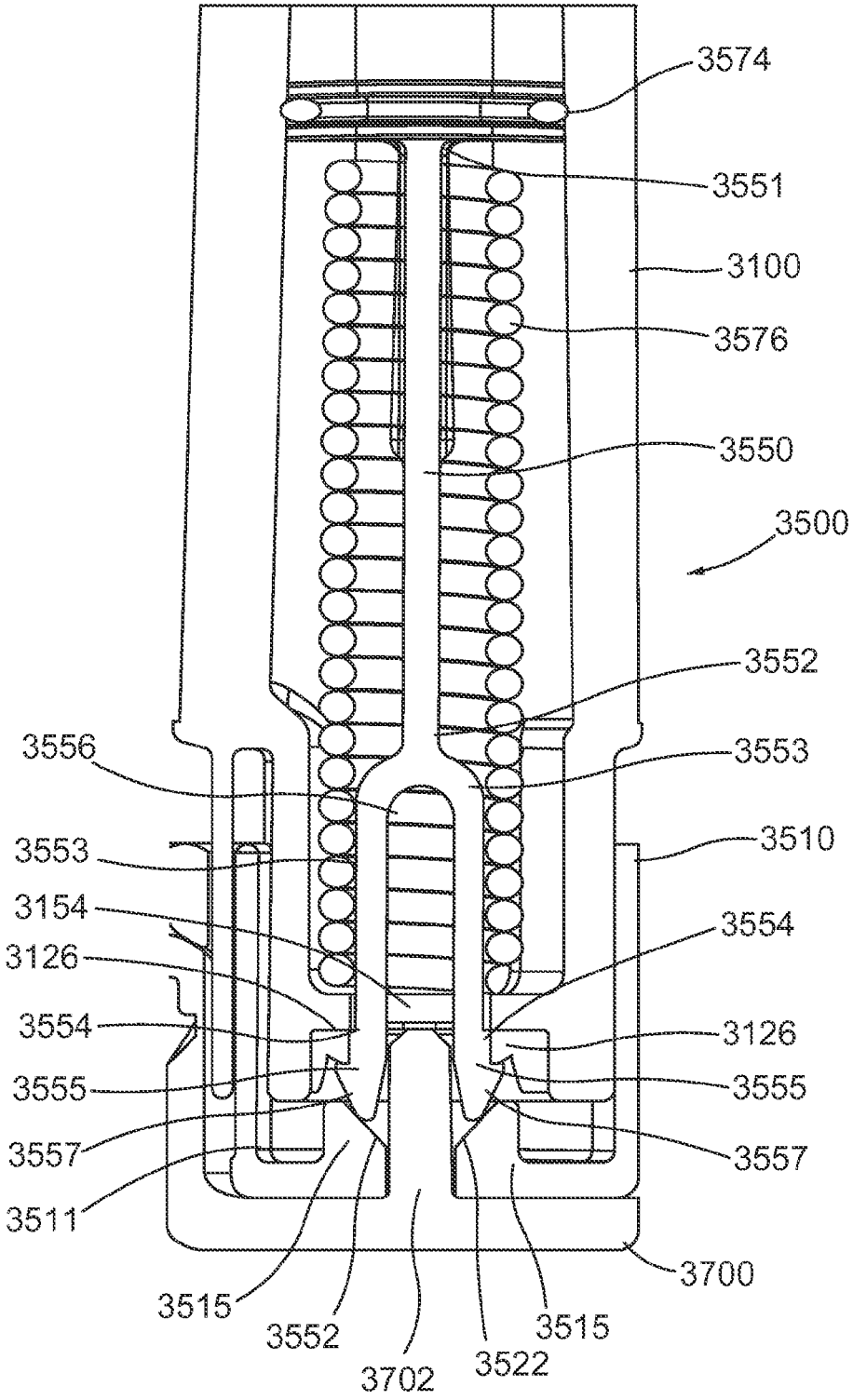
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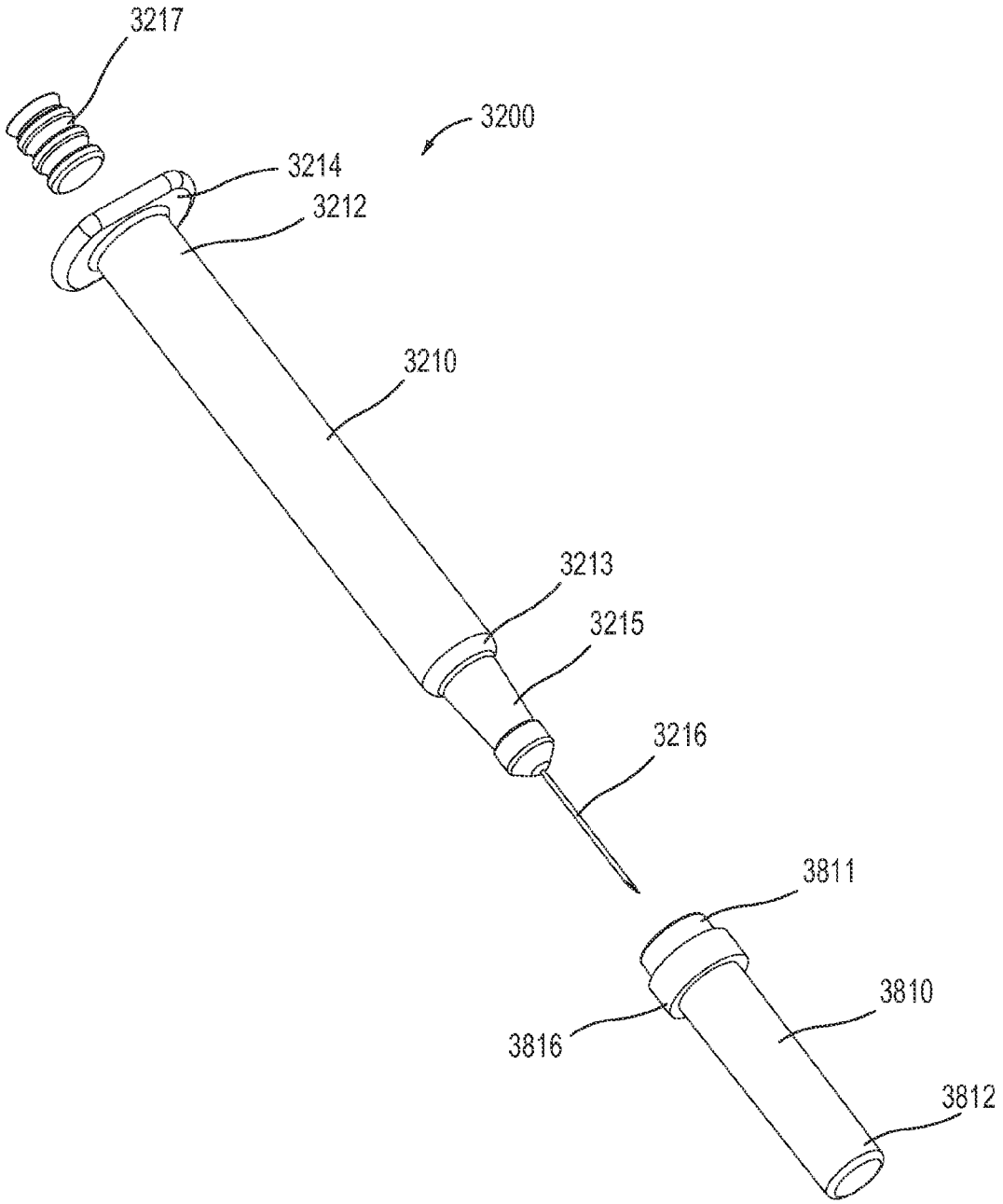
FIG.21



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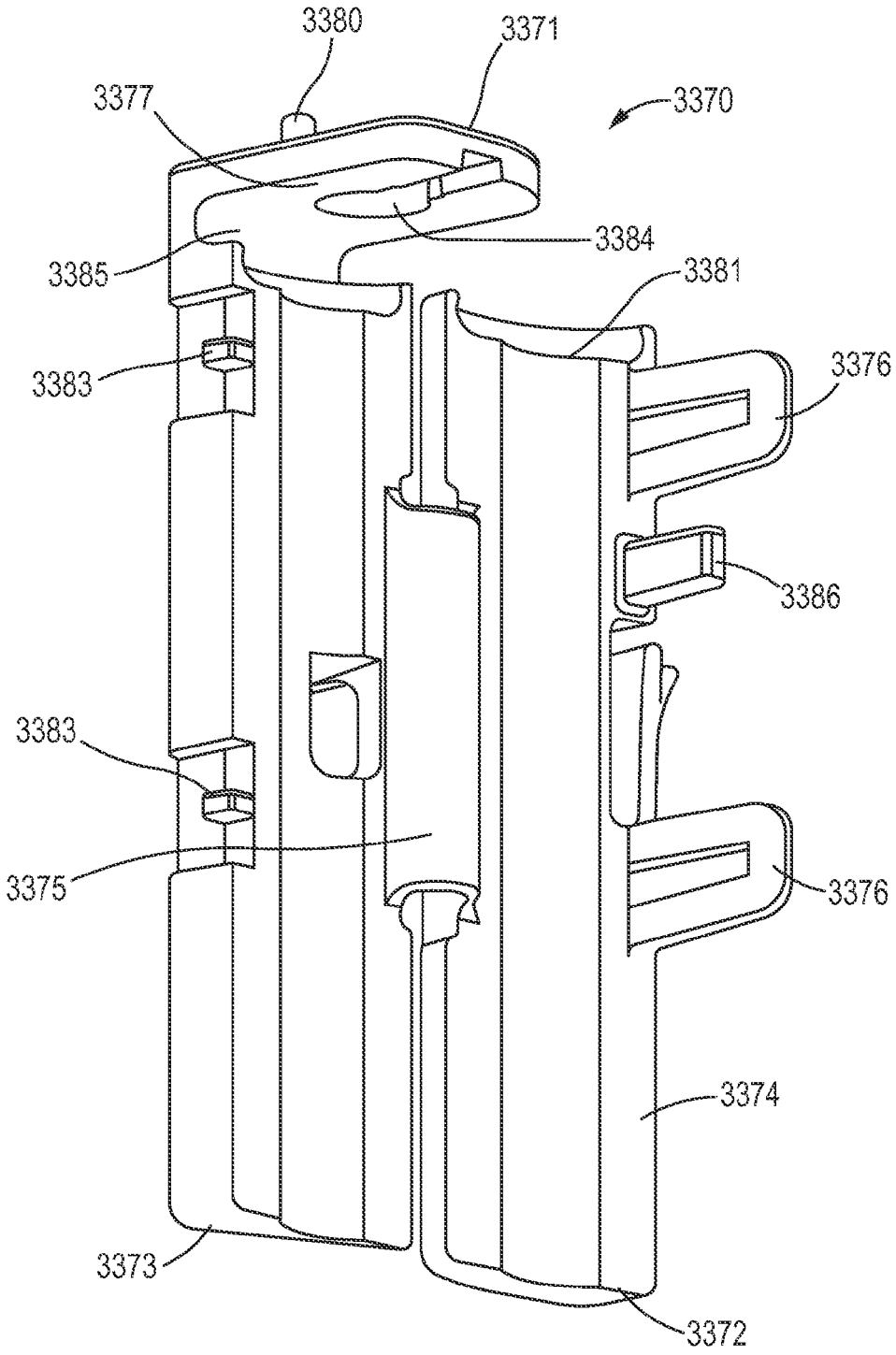
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FIG.23

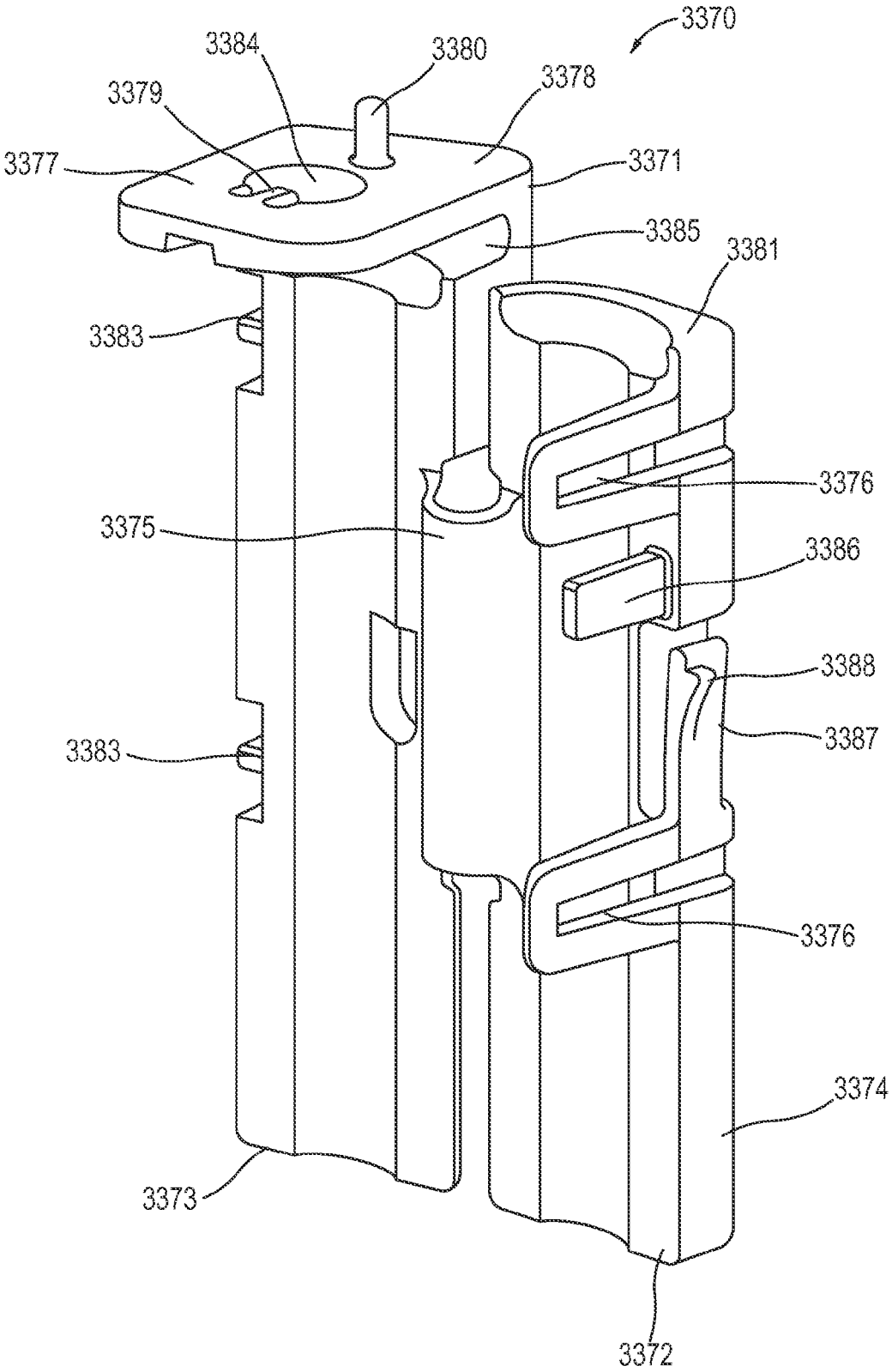
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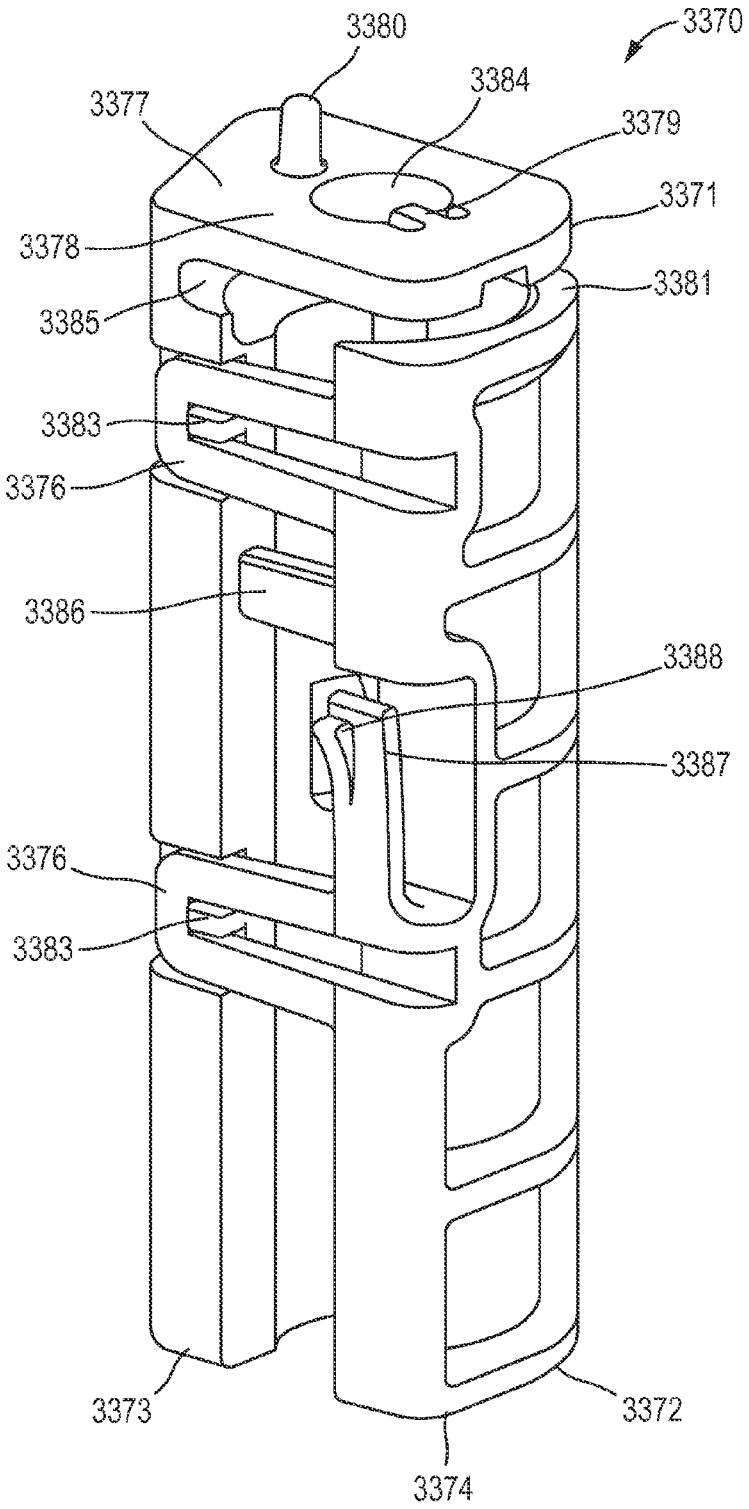
FIG.24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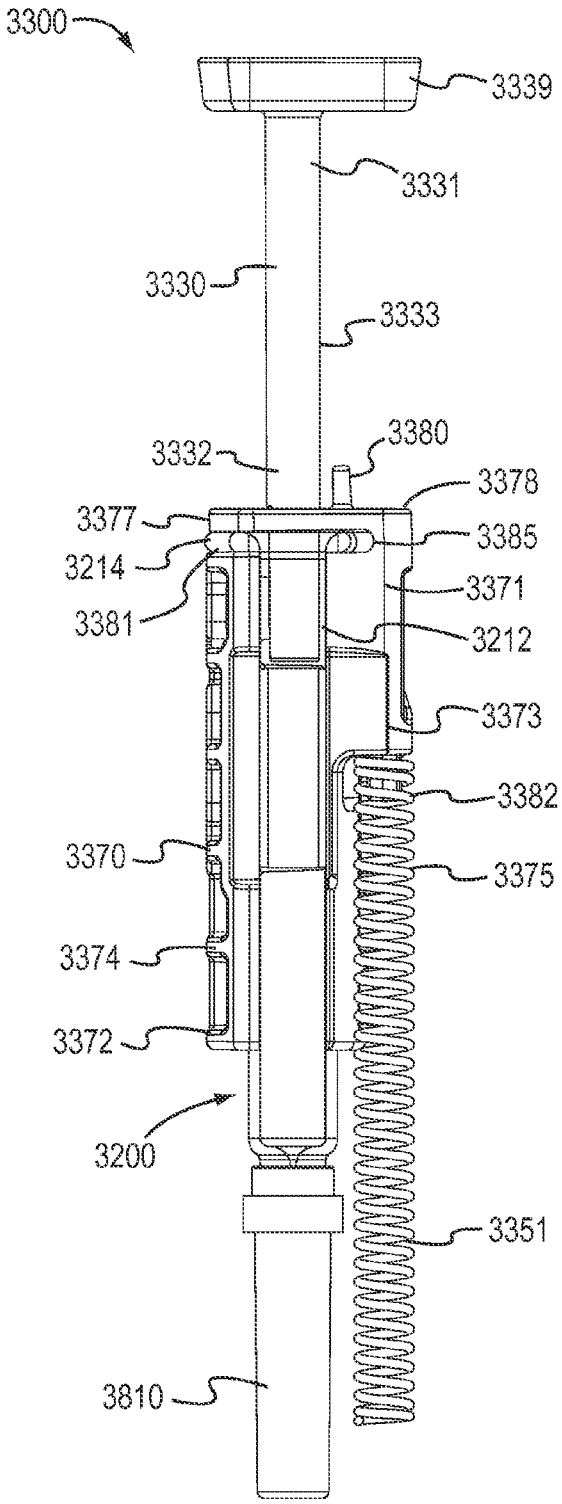
3376
3383
3373
3372
3374

FIG.25


3300
3339
3331
3330
3333
3332
3380
3378
3377
3385
3214
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3381
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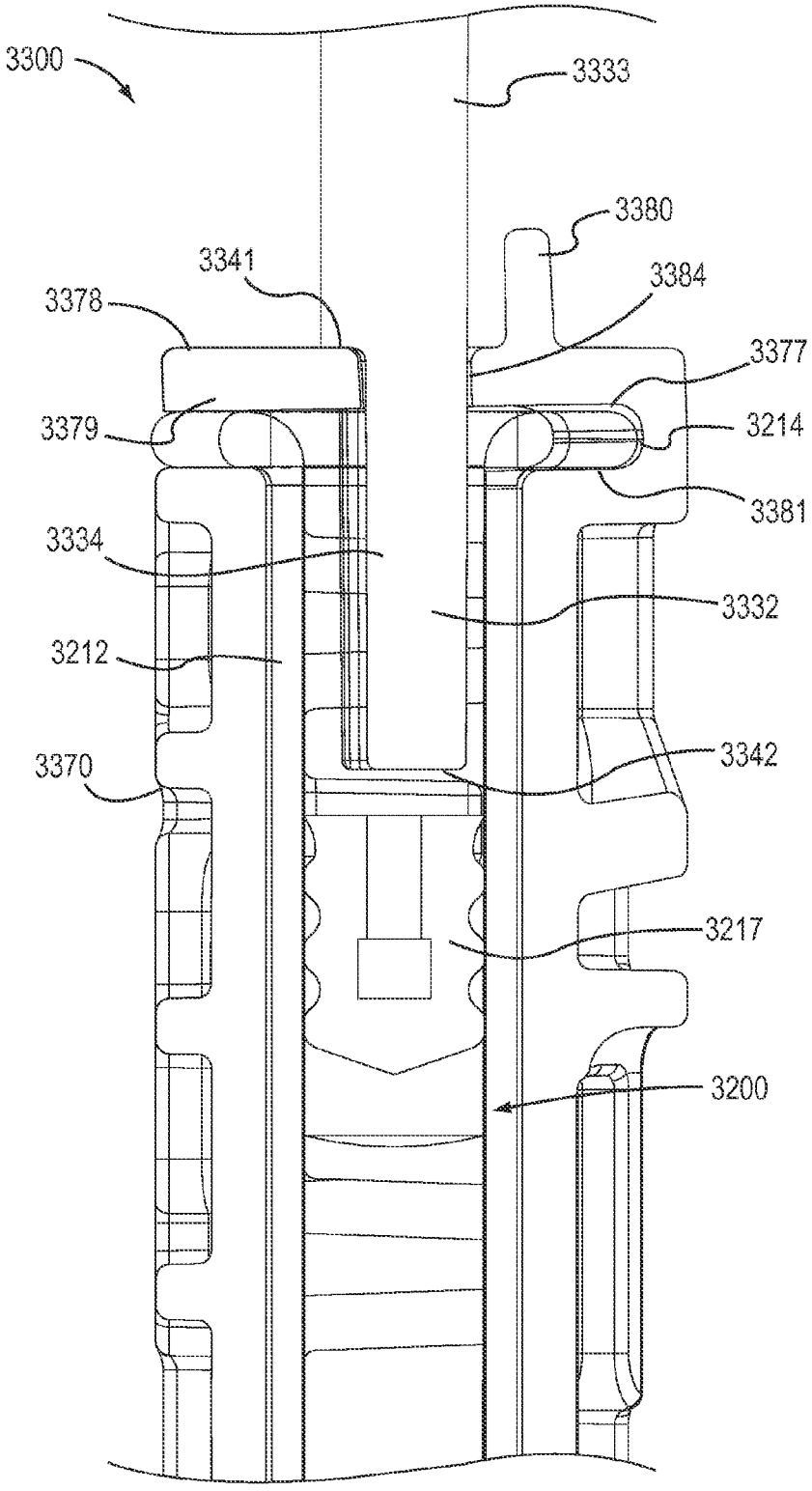
3382
3370
3375
3374
3372
3200
3351
3810

FIG.26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3377
3379
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3381
3334
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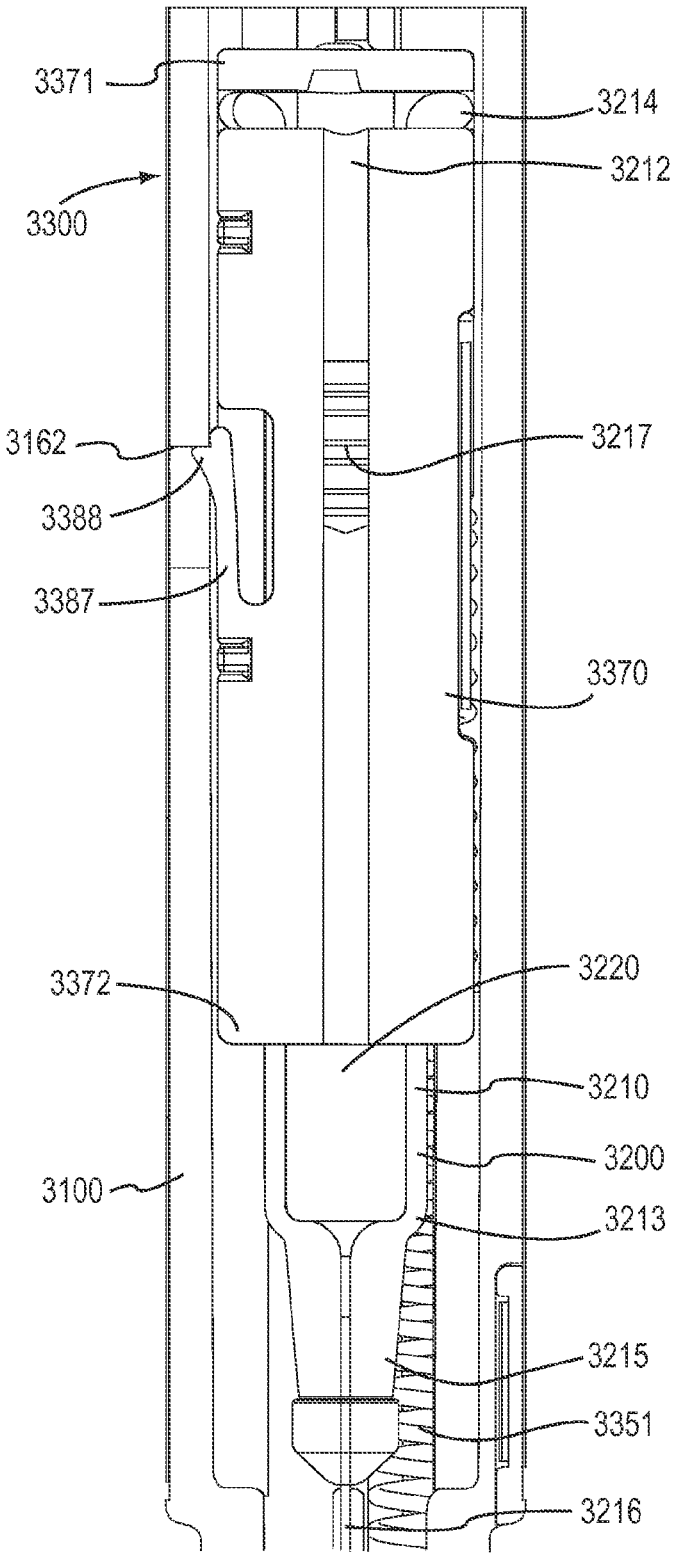
3212
3342
3370
3217
3200

FIG.27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3214
3212
3300
3162
3217
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3387
3370
3372
3220
3210
3200
3100
3213
3215
3351
3216

FIG.28

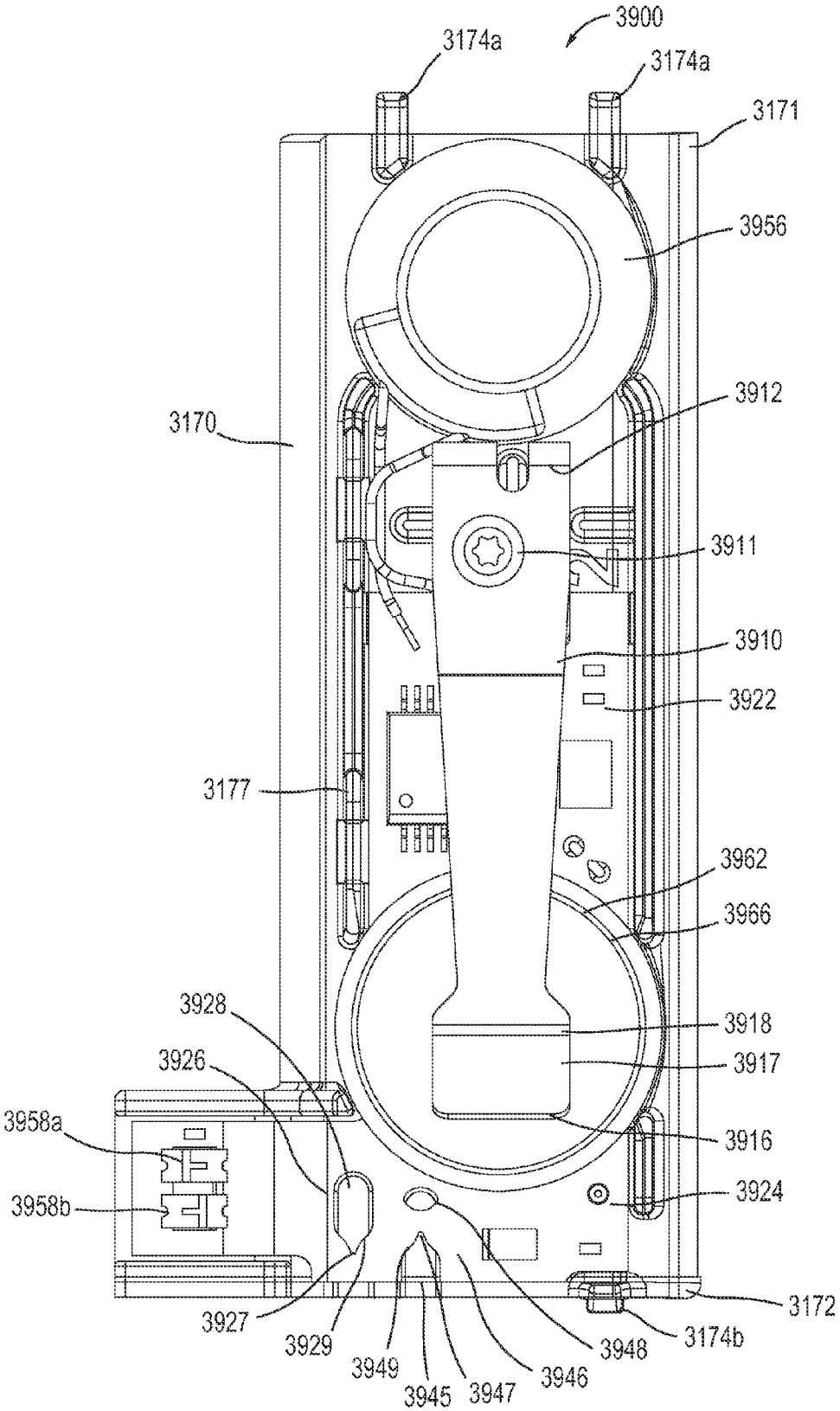

3900
3174a
3174a
3171
3956
3912
3170
3911
3910
3922
3177
3962
3966
3928
3918
3926
3917
3958a
3916
3924
3958b
3172
3927
3929
3949
3945
3947
3946
3948
3174b

FIG.29

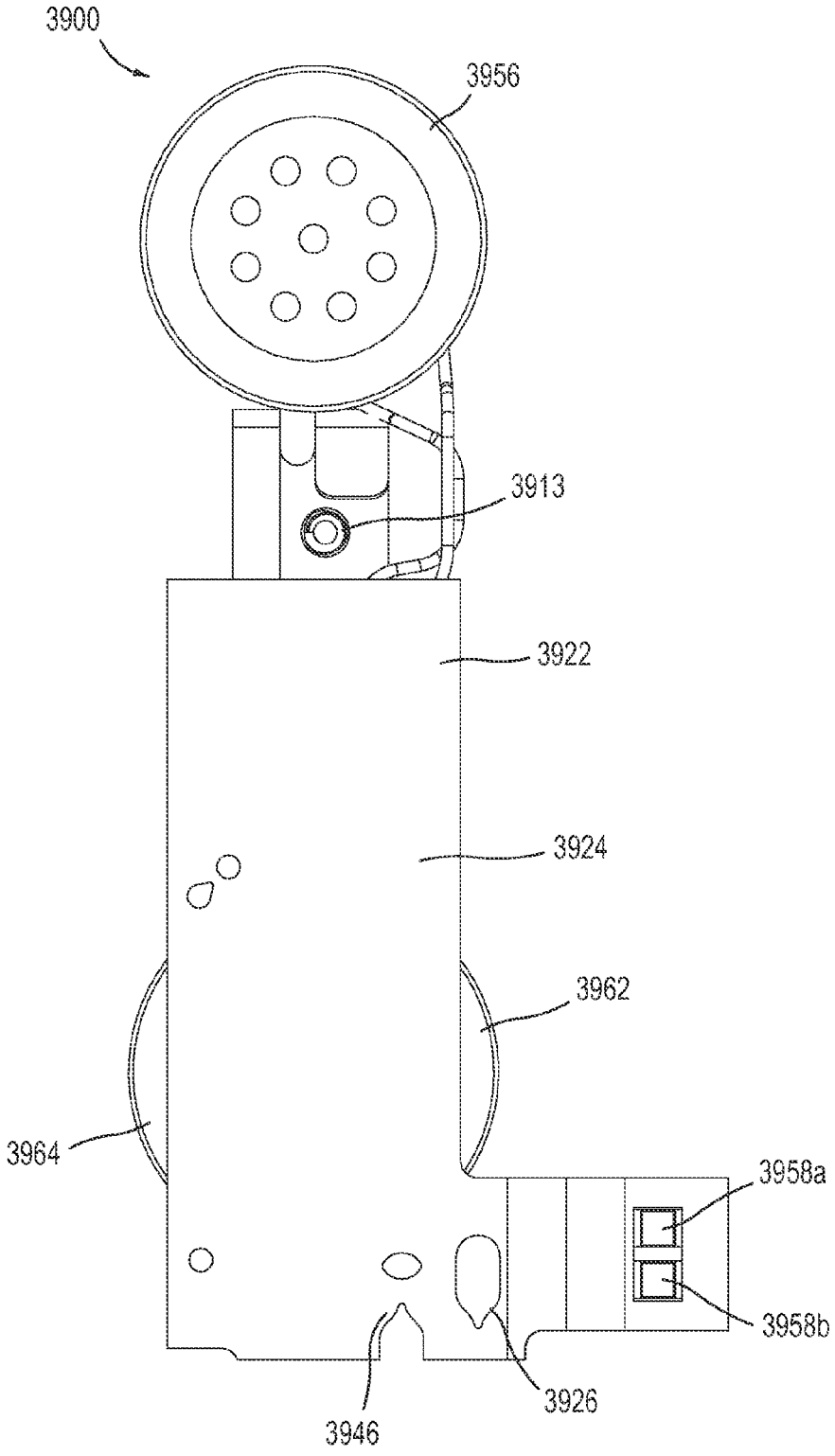
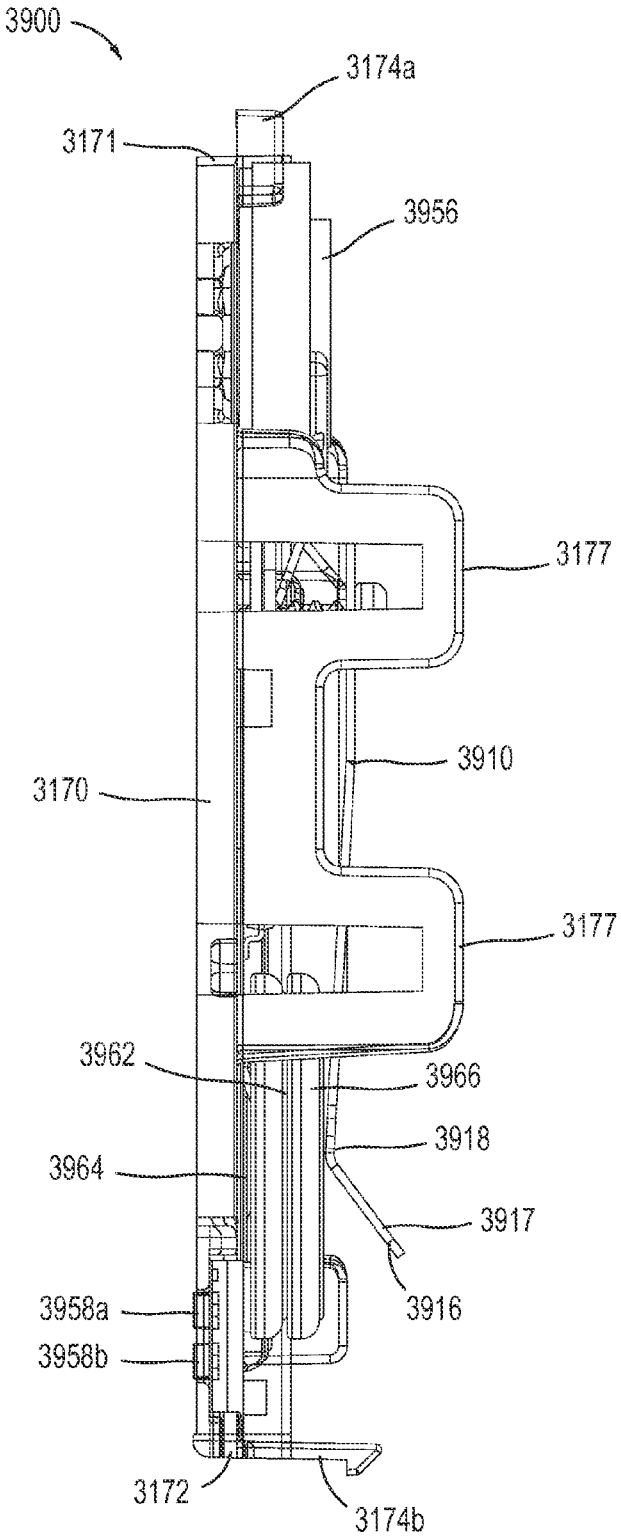


FIG.30


3900
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3171
3956
3177
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3962
3966
3918
3964
3917
3916
3958a
3958b
3172
3174b

FIG.31

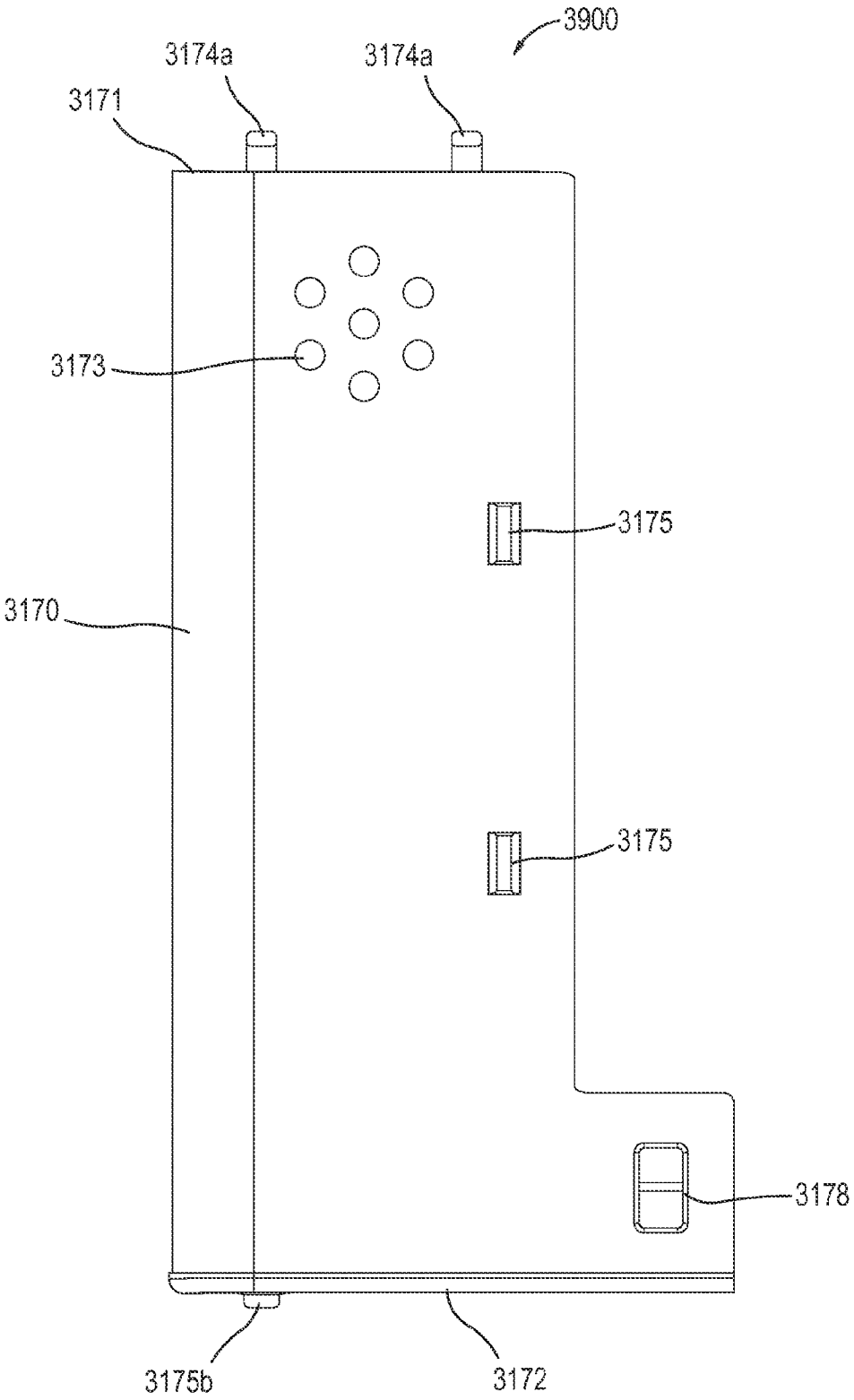
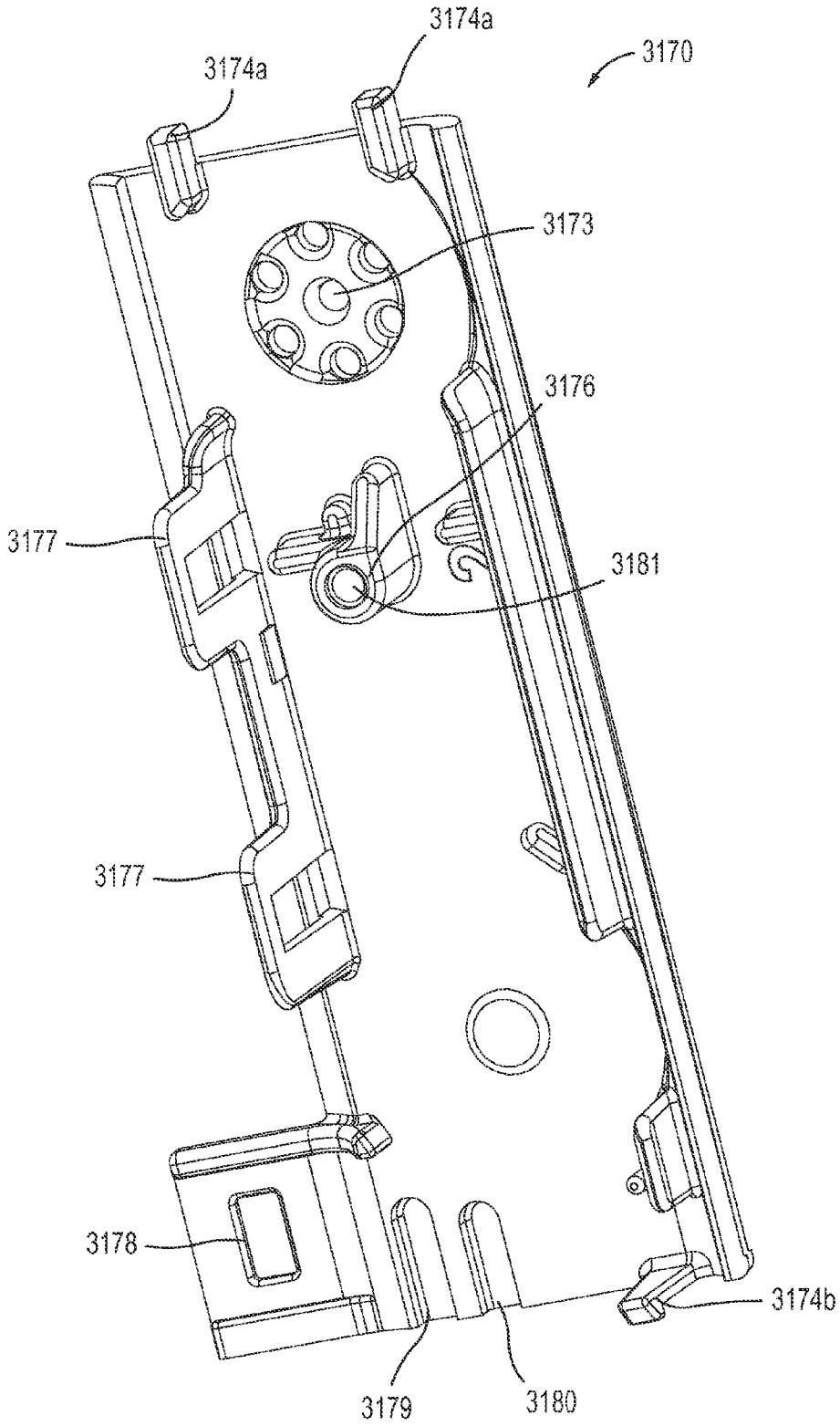


FIG.32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3174a
3170
3173
3176
3177
3181
3177
3178
3174b
3179
3180

FIG.33

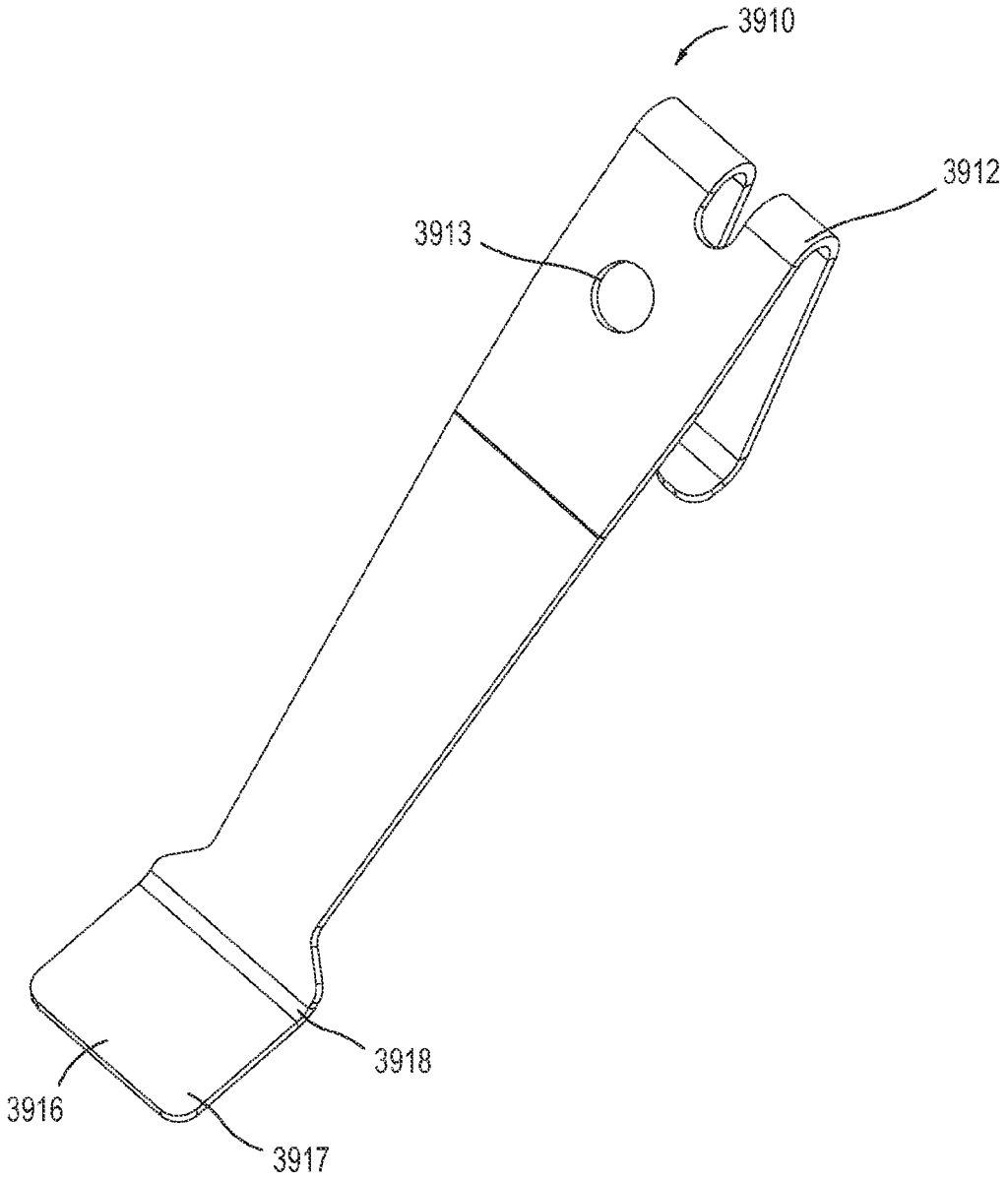
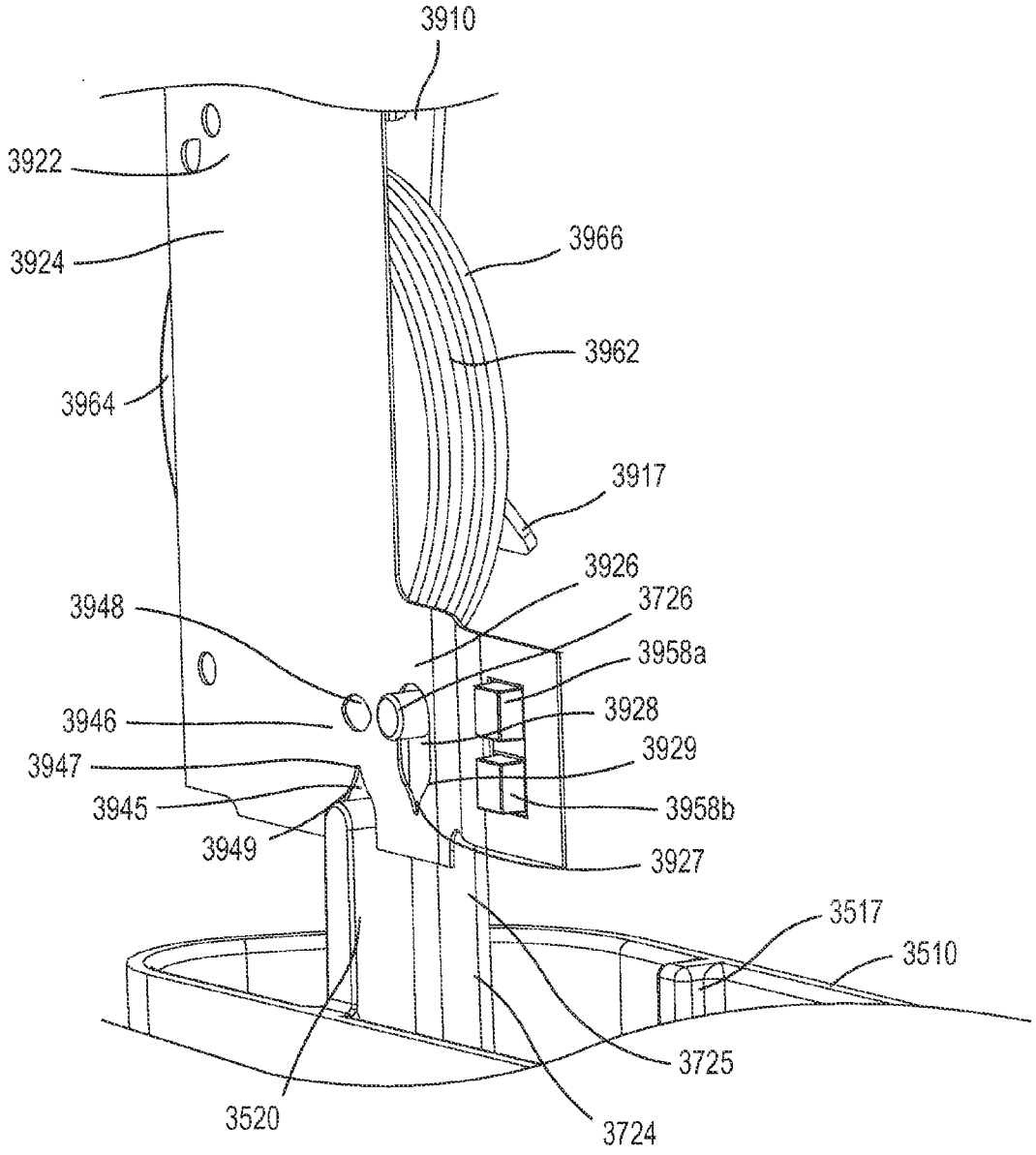


FIG.34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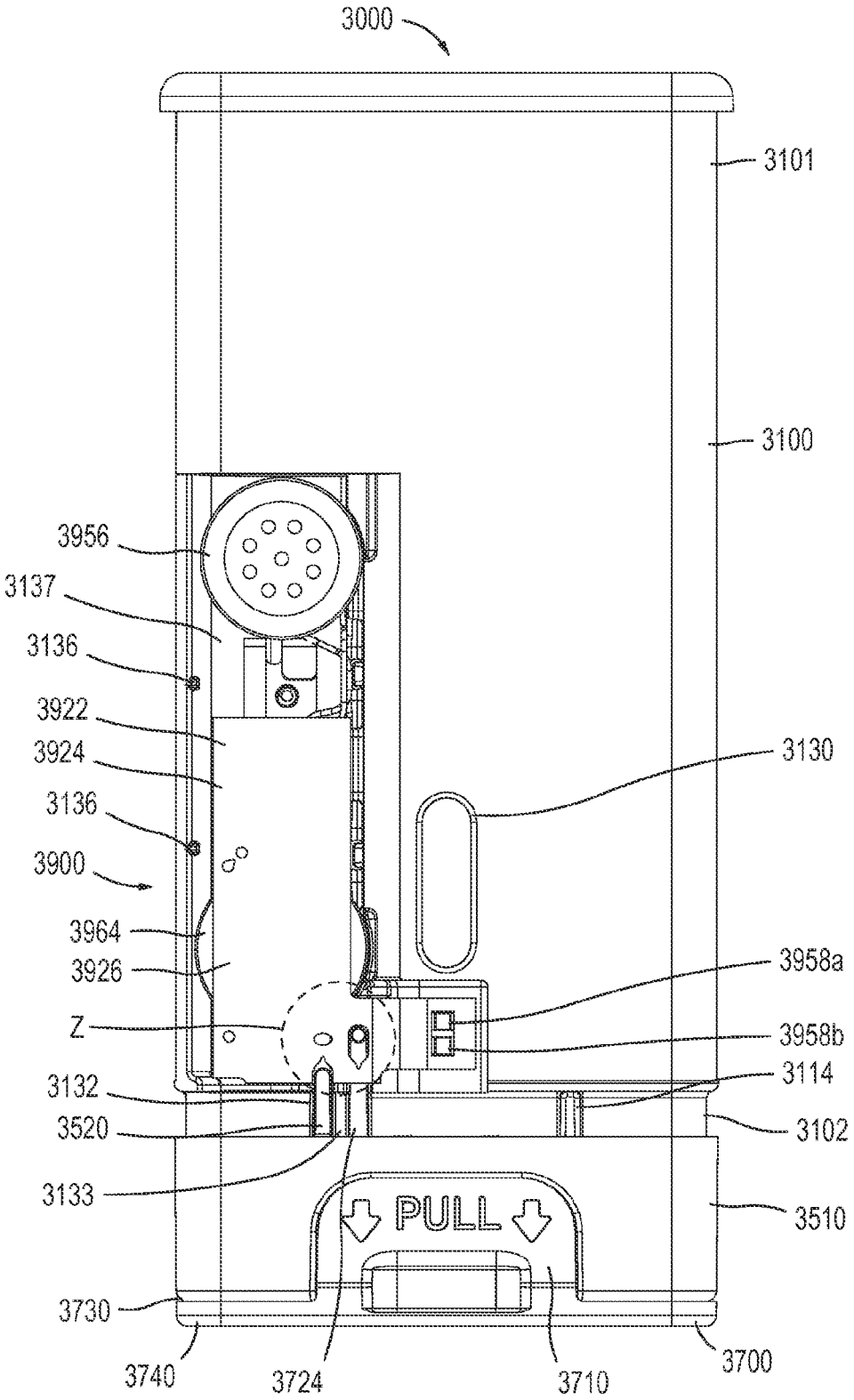
3922
3924
3966
3962
3964
3917
3926
3948
3726
3958a
3946
3928
3947
3929
3945
3958b
3949
3927
3517
3510
3725
3520
3724

FIG.35


3000
3101
3100
3956
3137
3136
3922
3924
3136
3900
3964
3926
Z
3132
3520
3133
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3958a
3958b
3114
3102
3510
PULL
3730
3740
3724
3710
3700

FIG.36

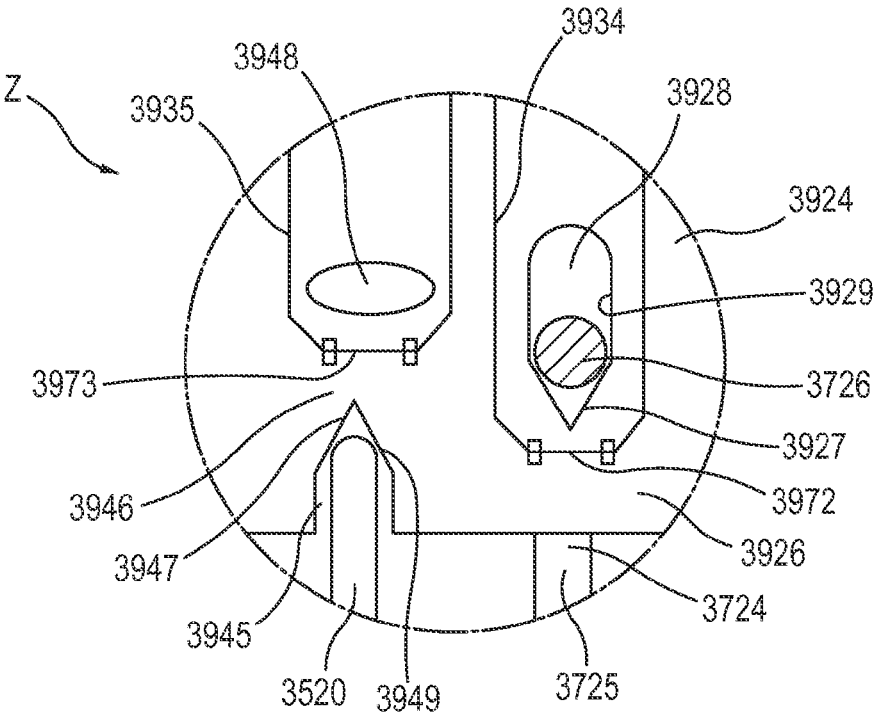

Z
3948
3934
3935
3928
3924
3929
3973
3726
3927
3946
3972
3947
3926
3724
3945
3520
3949
3725

FIG.37

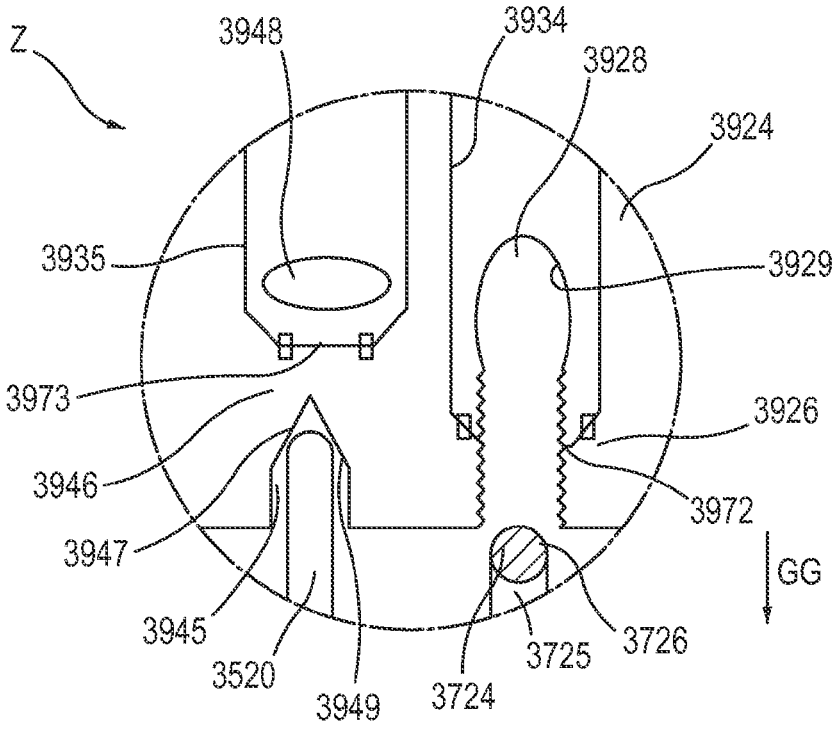

Z
3948
3934
3928
3924
3935
3929
3973
3926
3946
3972
3947
GG
3945
3725
3726
3520
3724
3949

FIG.38

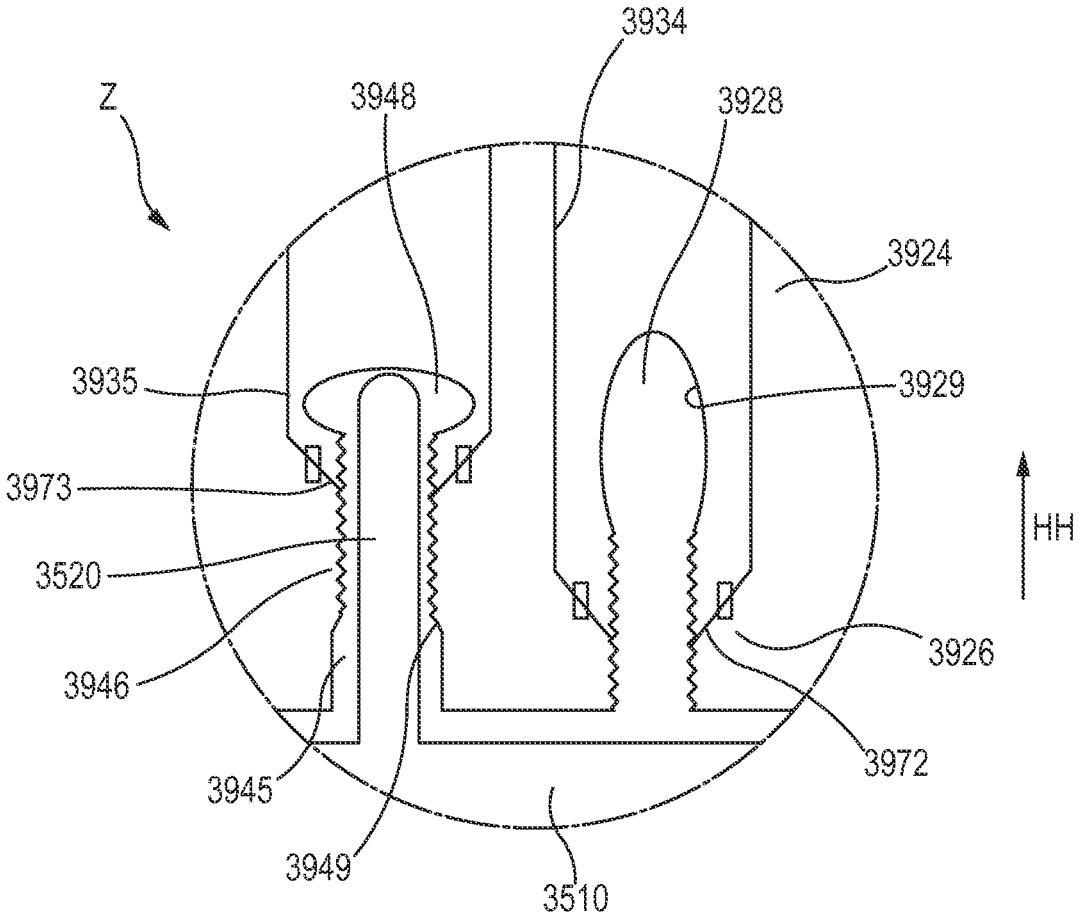

Z
3948
3934
3928
3924
3935
3929
3973
3520
3946
3926
3945
3972
3949
3510
HH

FIG.39

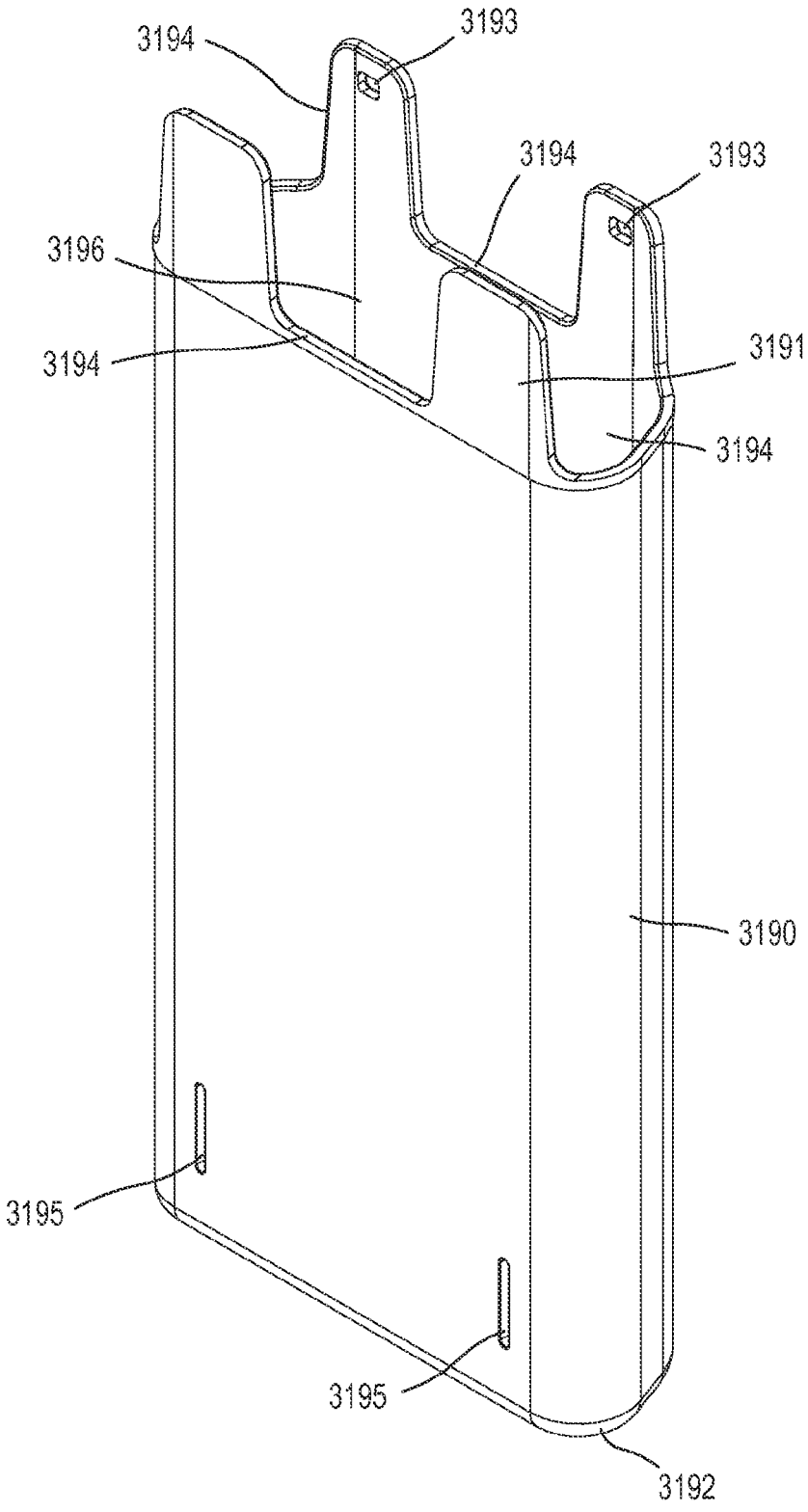


FIG.40

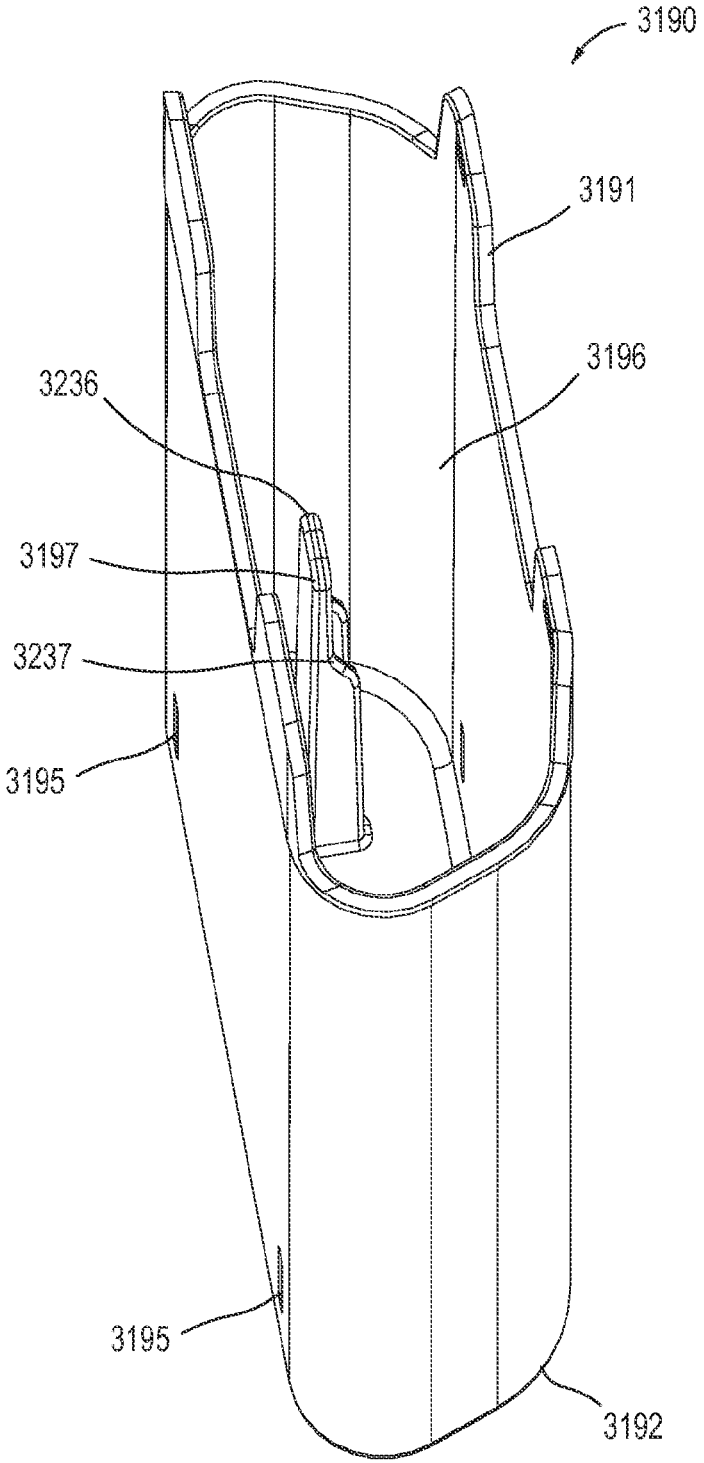


FIG.41

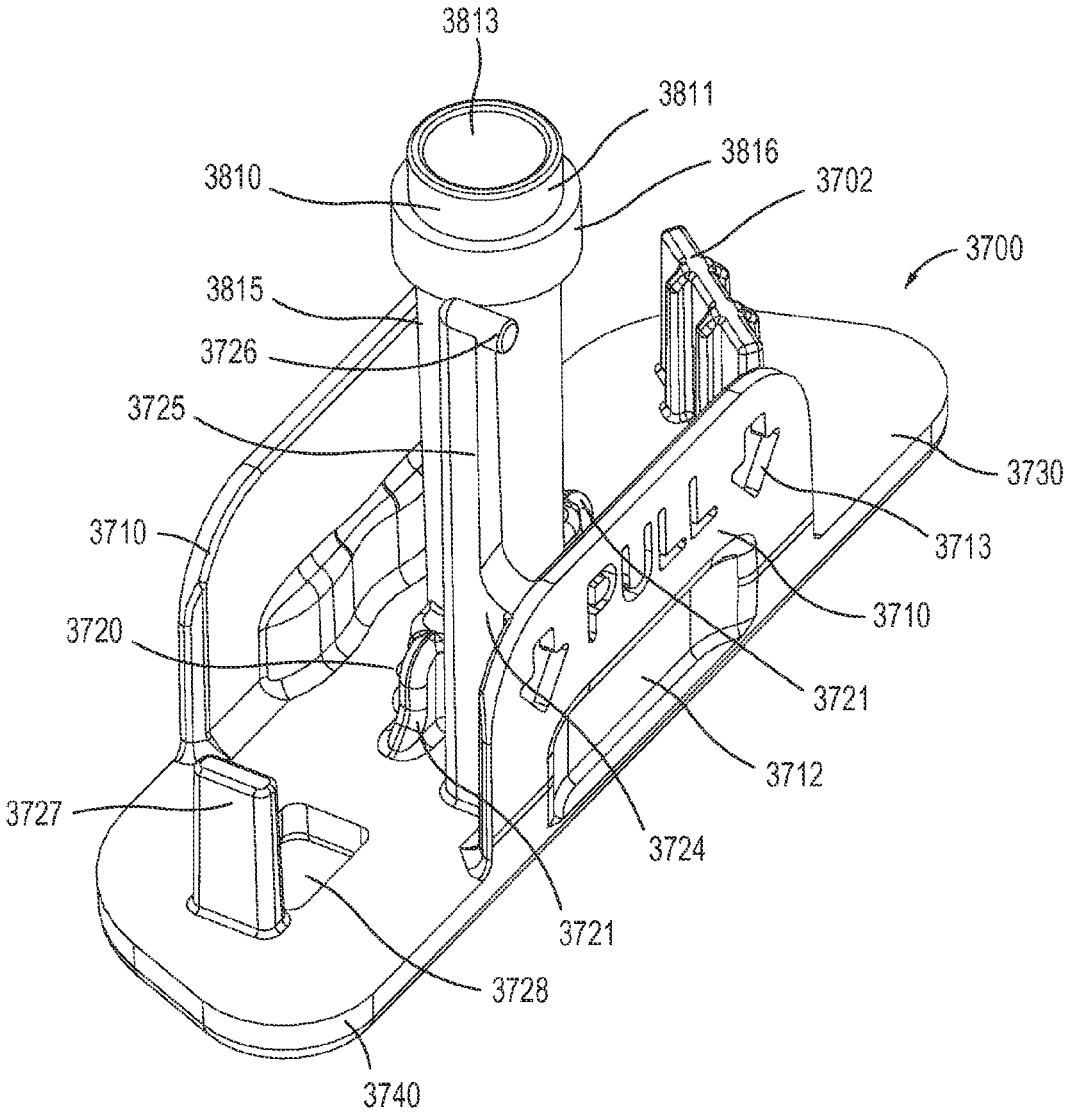

3813
3811
3816
3810
3702
3700
3815
3726
3725
3730
3710
3713
3720
3710
3721
3712
3727
3724
3721
3728
3740

FIG.42

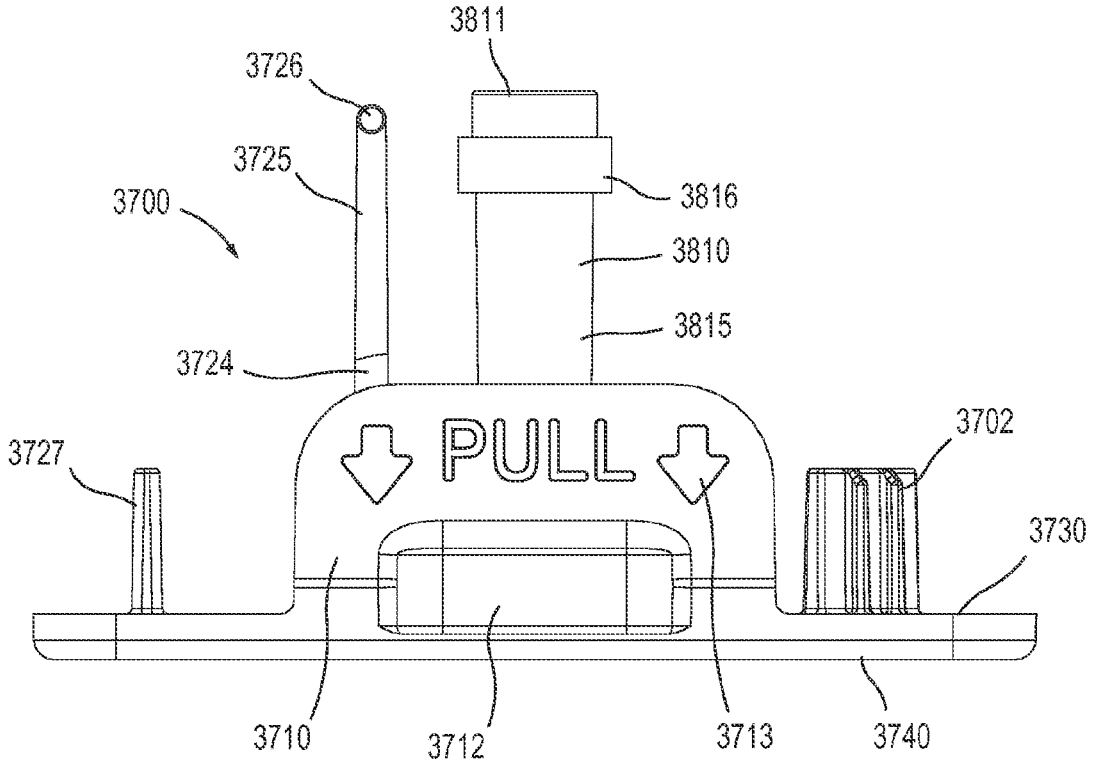

3811
3726
3725
3700
3816
3810
3815
3724
PULL
3702
3727
3730
3710
3712
3713
3740

FIG.43

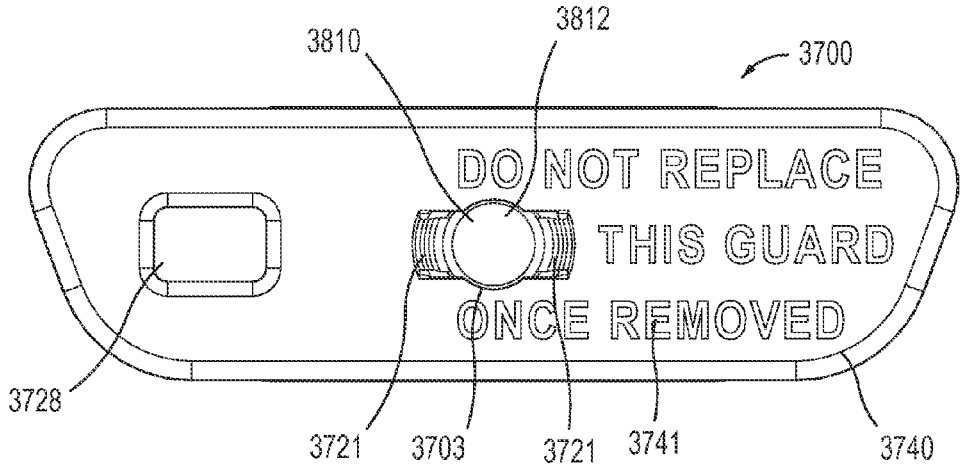

3810
3812
3700
DO NOT REPLACE
THIS GUARD
ONCE REMOVED
3728
3721
3703
3721
3741
3740

FIG.44

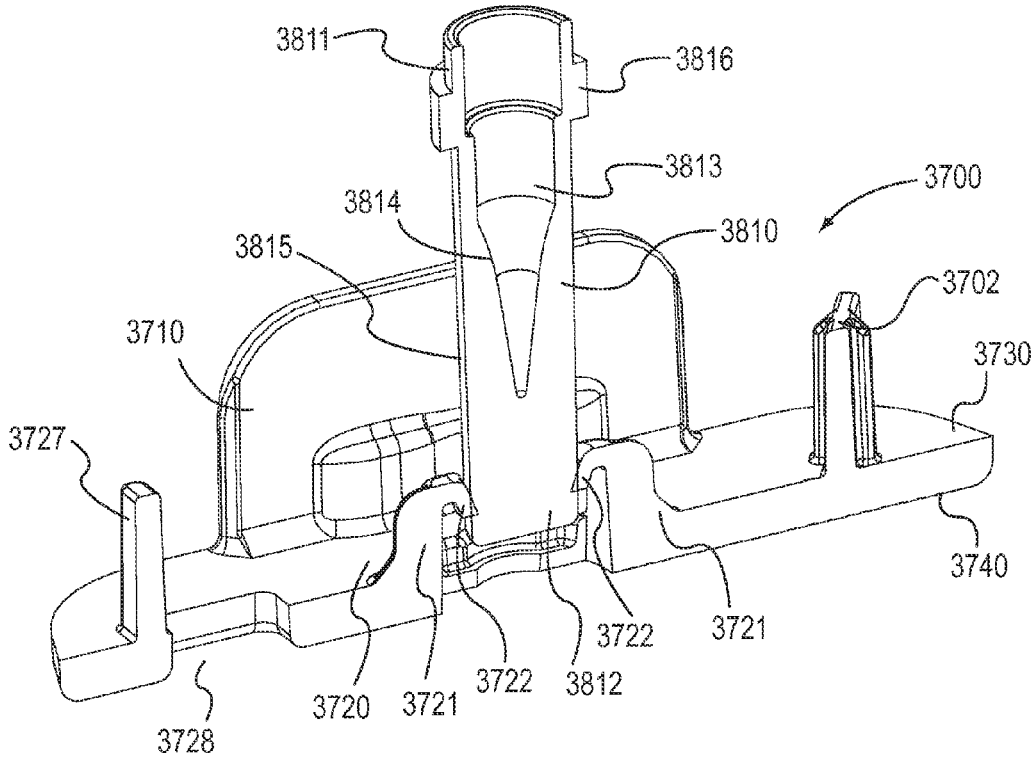

3811
3816
3813
3700
3814
3810
3815
3702
3710
3730
3727
3740
3722
3721
3720
3721
3722
3812
3728

FIG.45

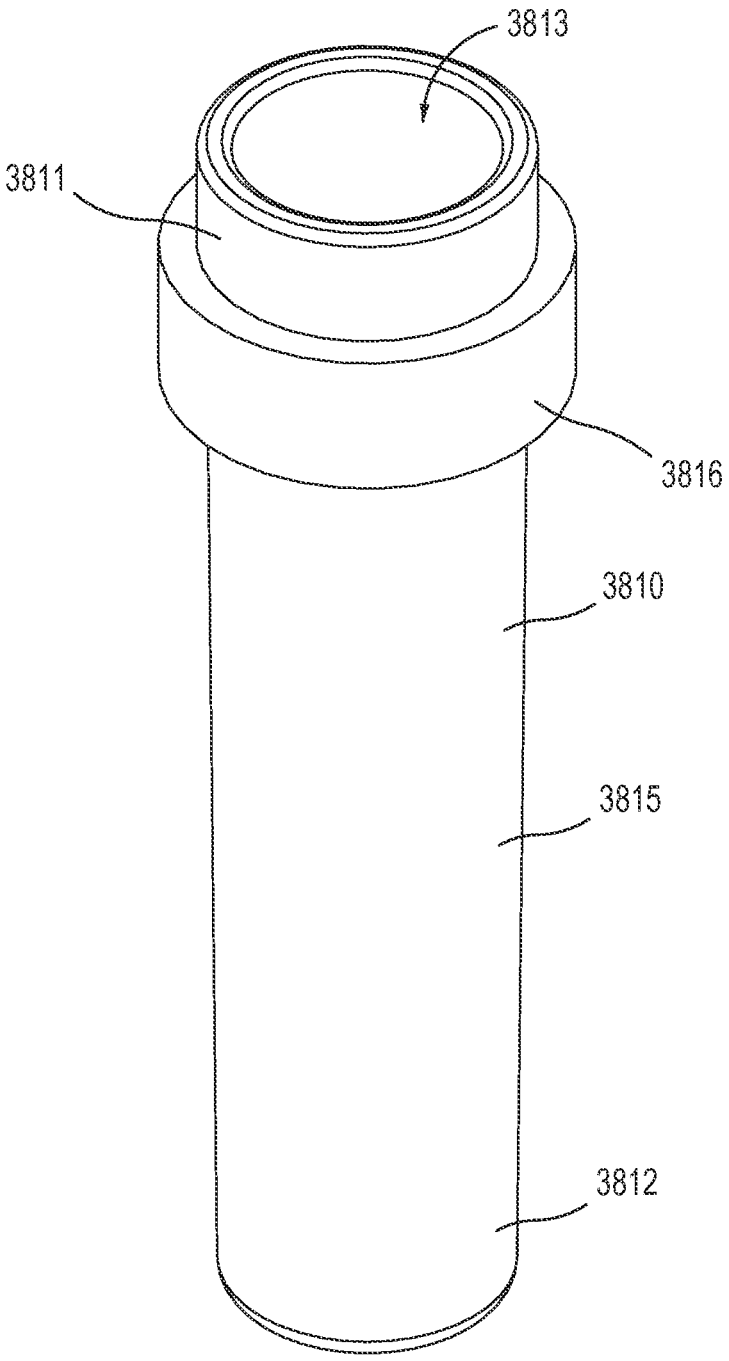


FIG.46

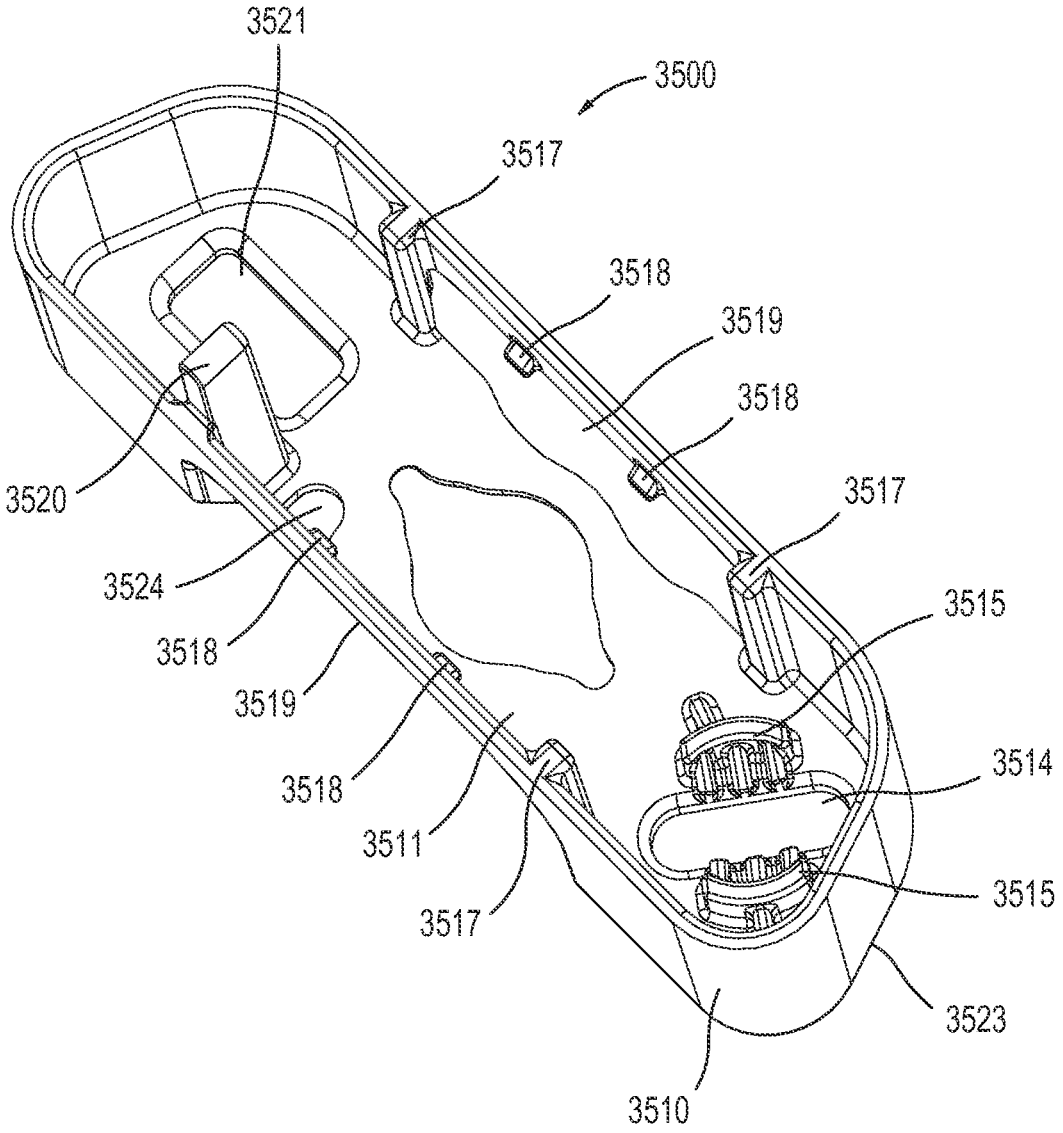

3521
3500
3517
3518
3519
3518
3520
3517
3524
3515
3518
3519
3514
3518
3511
3515
3517
3523
3510

FIG.47

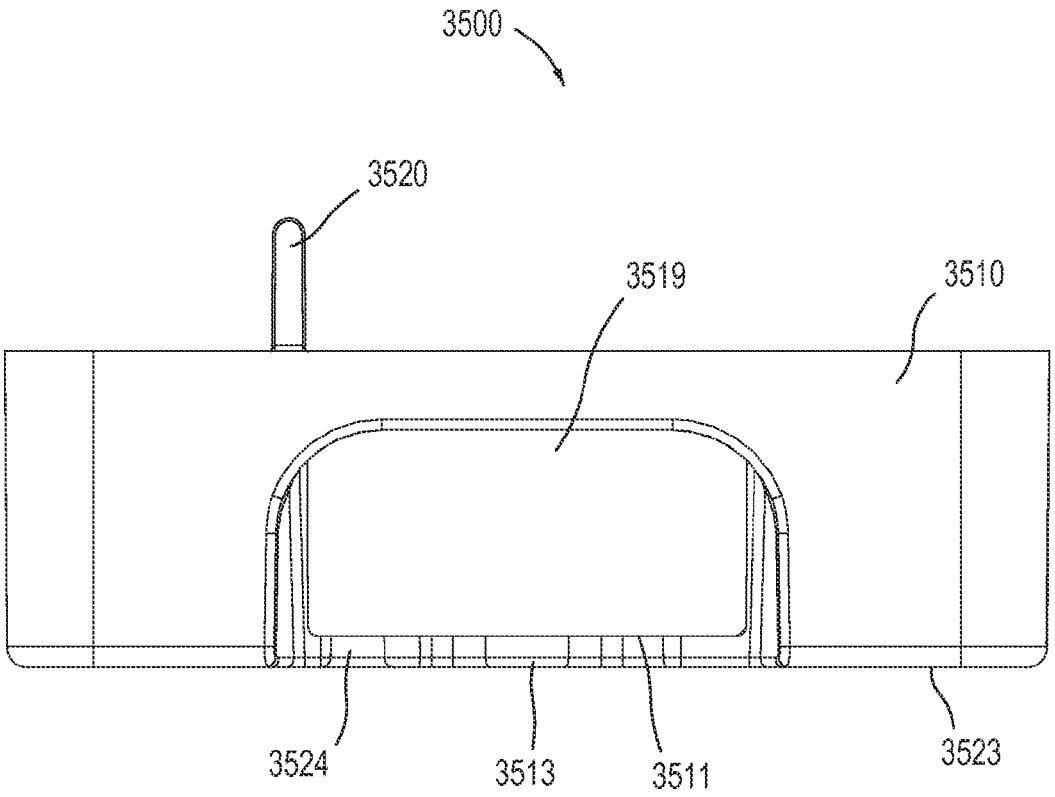


FIG.48

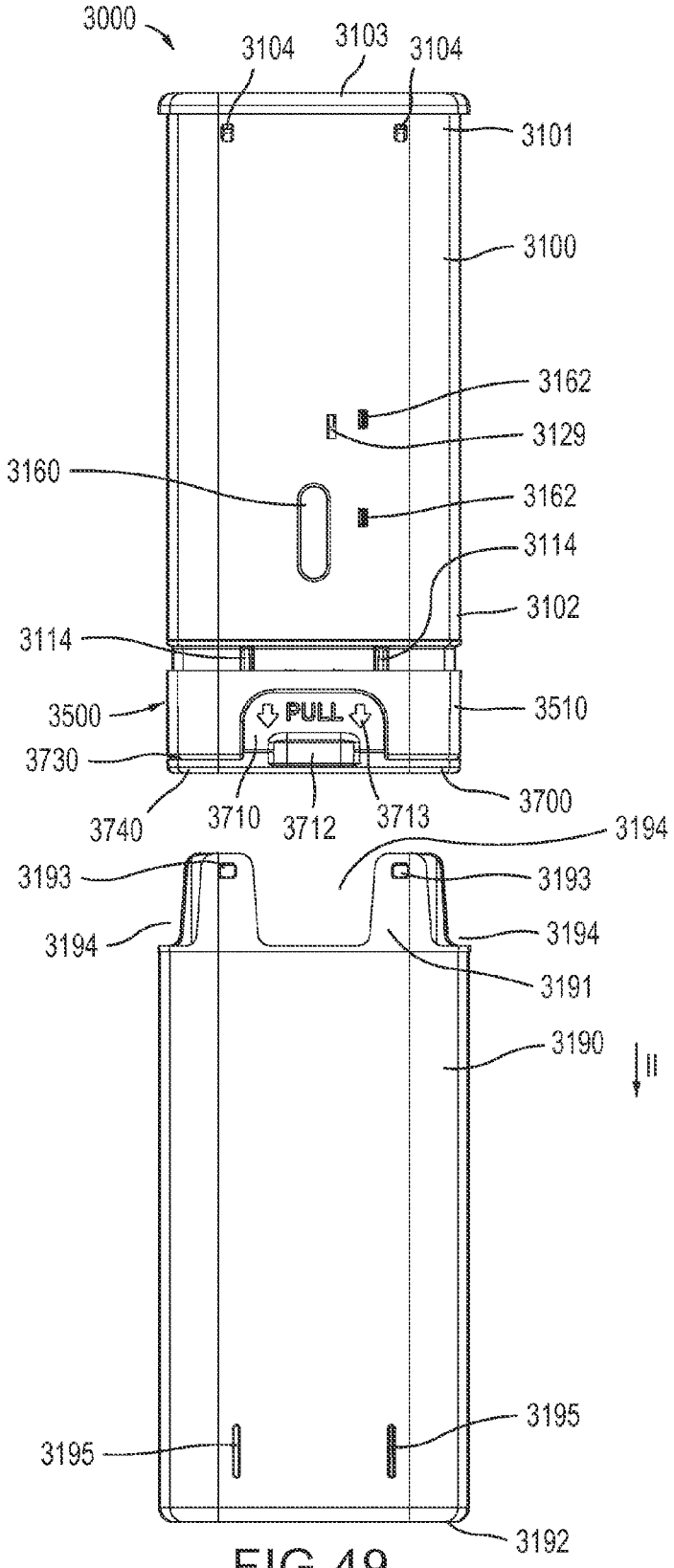

3000
3104
3103
3104
3101
3100
3162
3129
3160
3162
3114
3102
3114
3500
PULL
3510
3730
3740
3710
3712
3713
3700
3194
3193
3193
3194
3194
3191
3190
II
3195
3195
3192

FIG.49

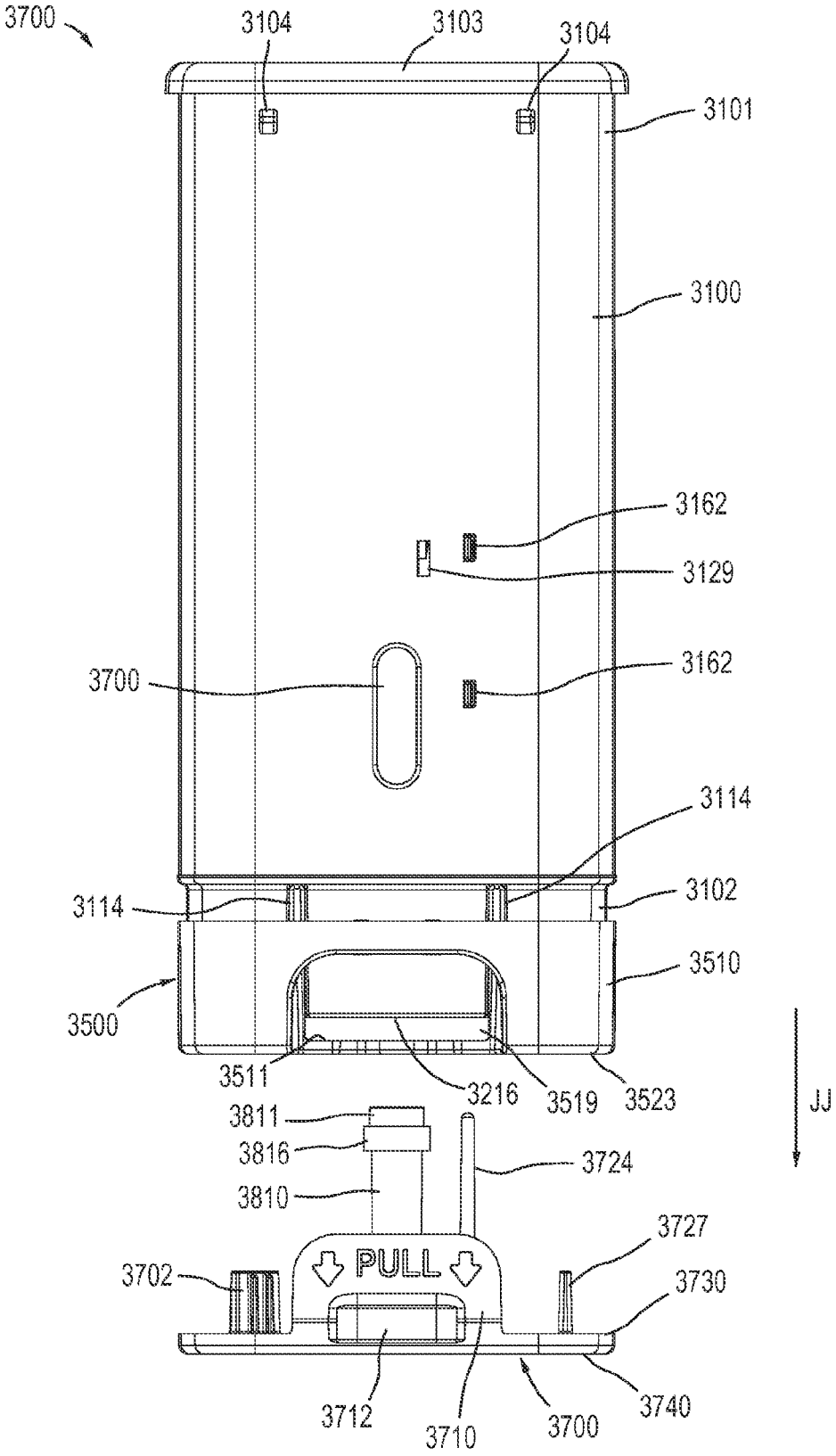

3700
3104
3103
3104
3101
3100
3162
3129
3700
3162
3114
3114
3102
3510
3500
3511
3216
3519
3523
JJ
3811
3816
3724
3810
3727
3702
PULL
3730
3712
3710
3700
3740

FIG.50

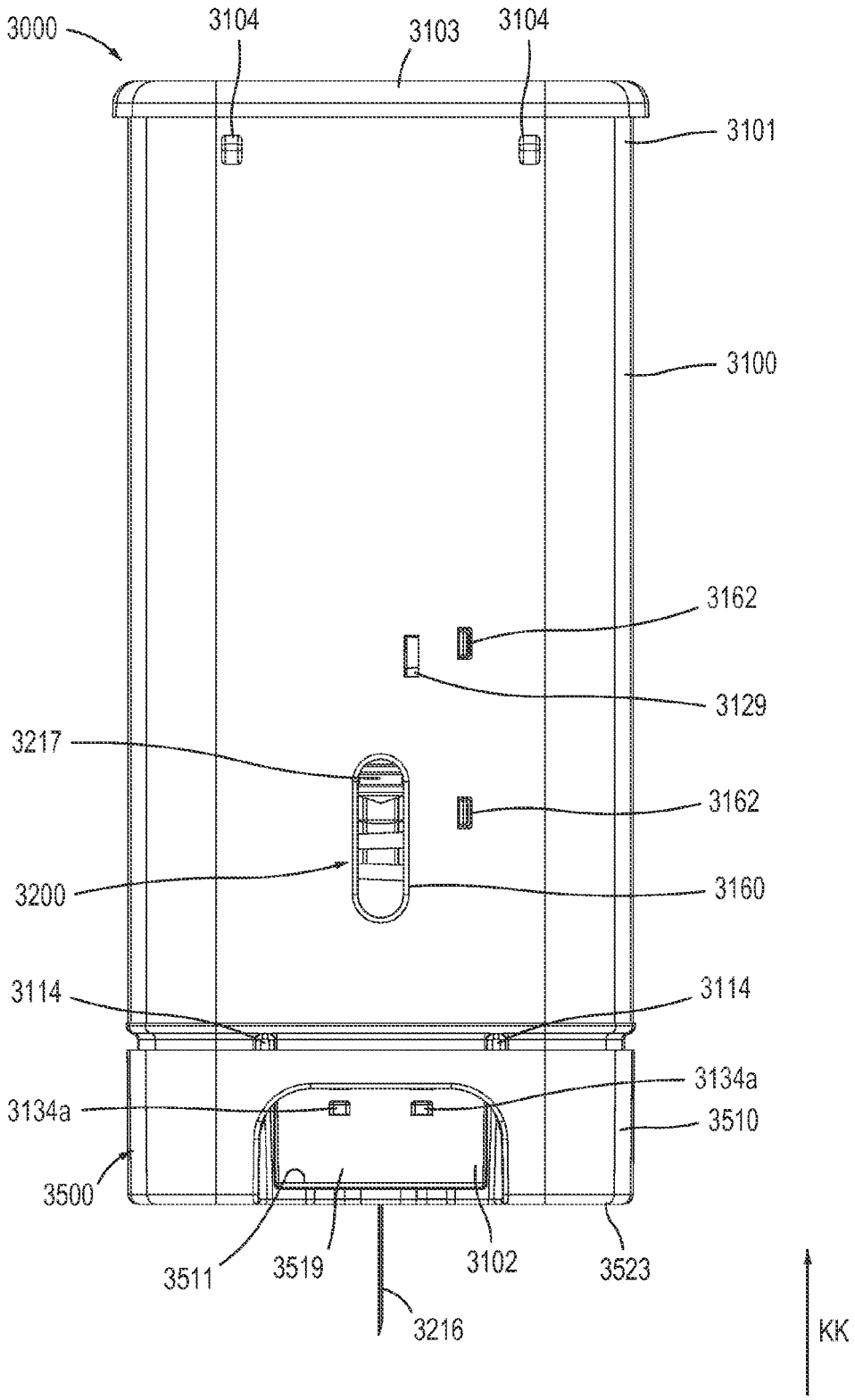
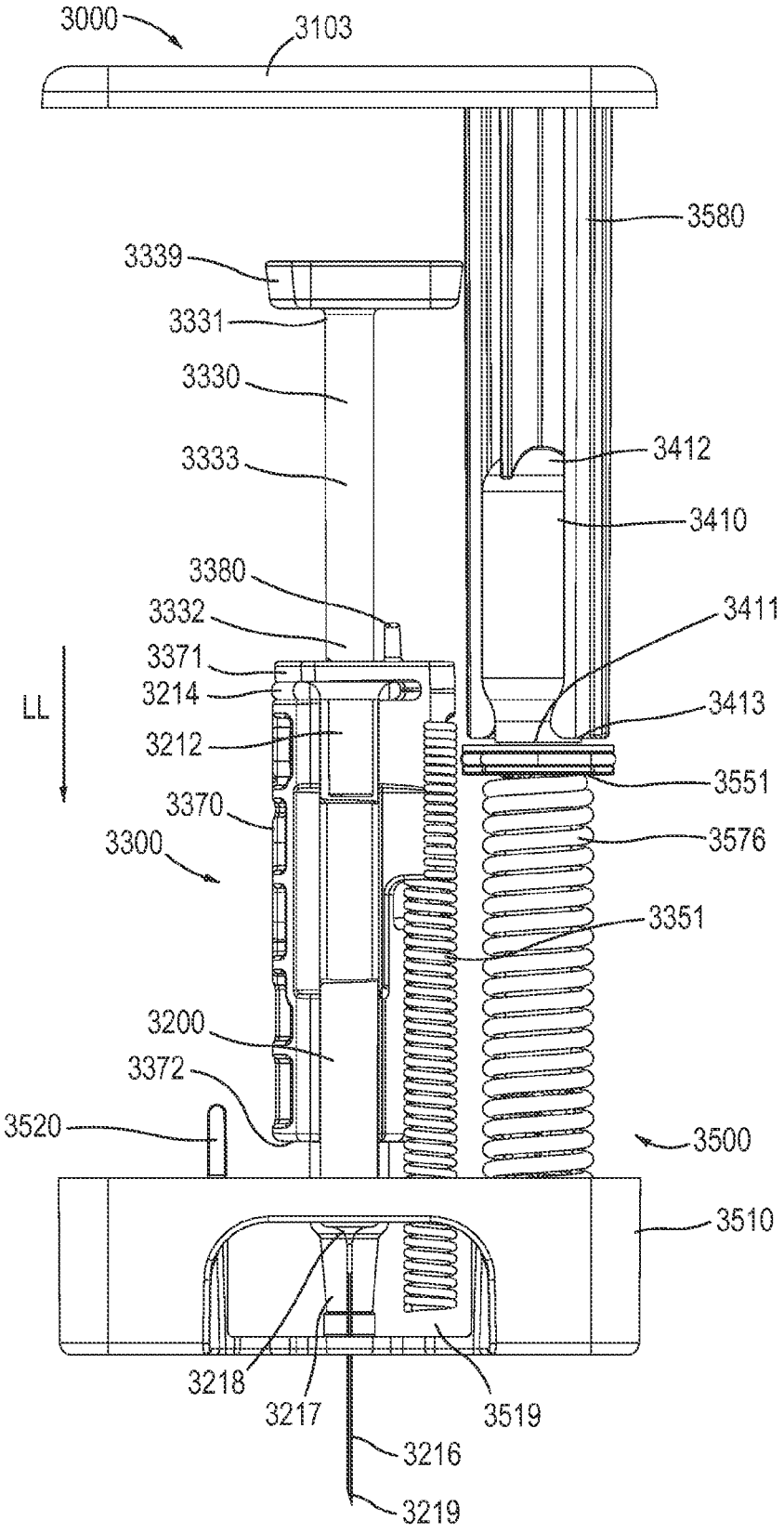

3000
3104
3103
3104
3101
3100
3162
3129
3217
3162
3200
3160
3114
3114
3134a
3134a
3510
3500
3511
3519
3102
3523
3216
KK

FIG.51


3000
3103
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3339
3331
3330
3333
3412
3410
3380
3332
3411
3371
3214
LL
3413
3212
3551
3370
3576
3300
3351
3200
3372
3520
3500
3510
3218
3217
3519
3216
3219

FIG.52

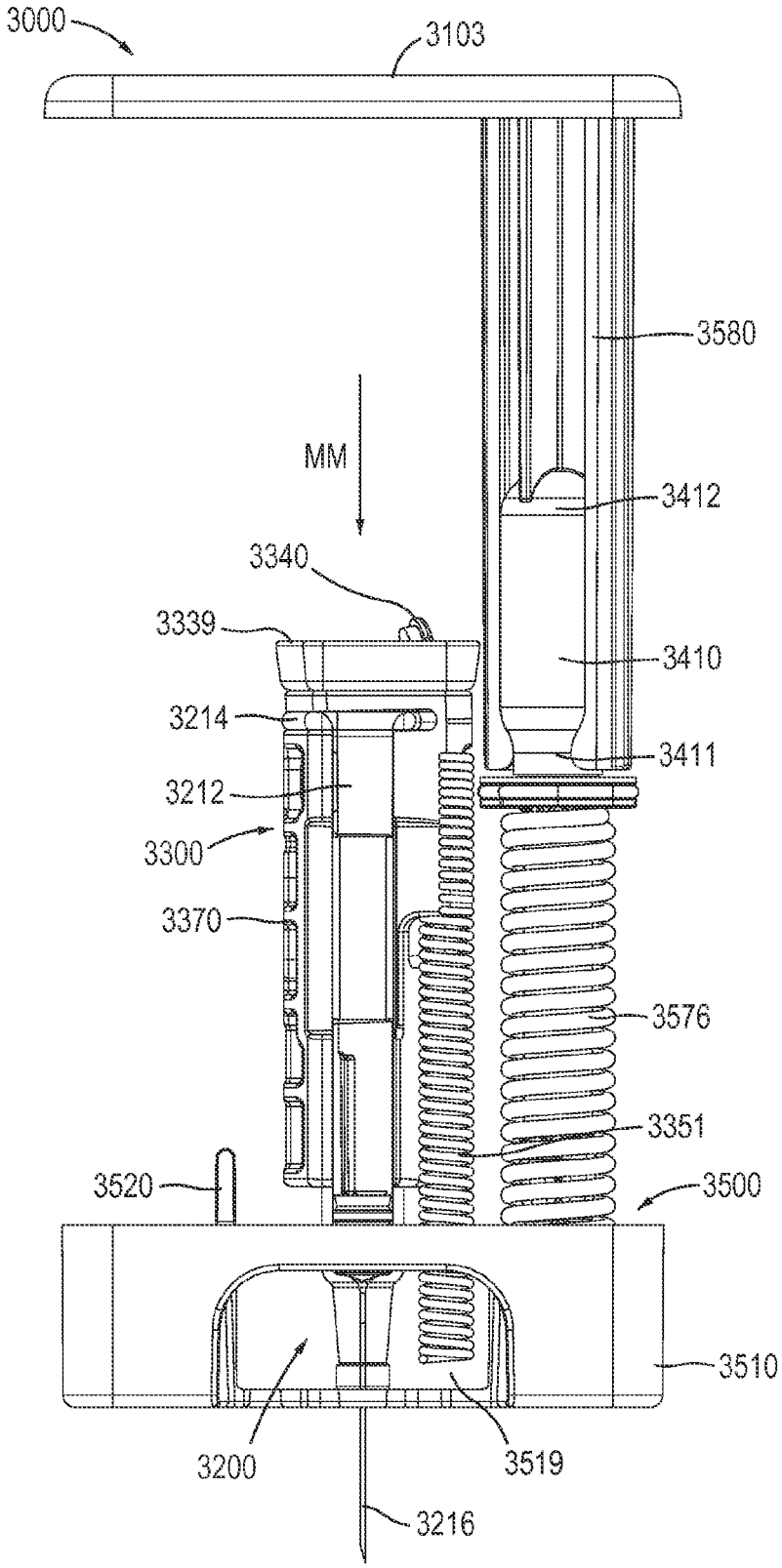
3000
3103
3580
MM
3412
3340
3339
3410
3214
3411
3212
3300
3370
3576
3351
3520
3500
3510
3200
3519
3216

FIG.53

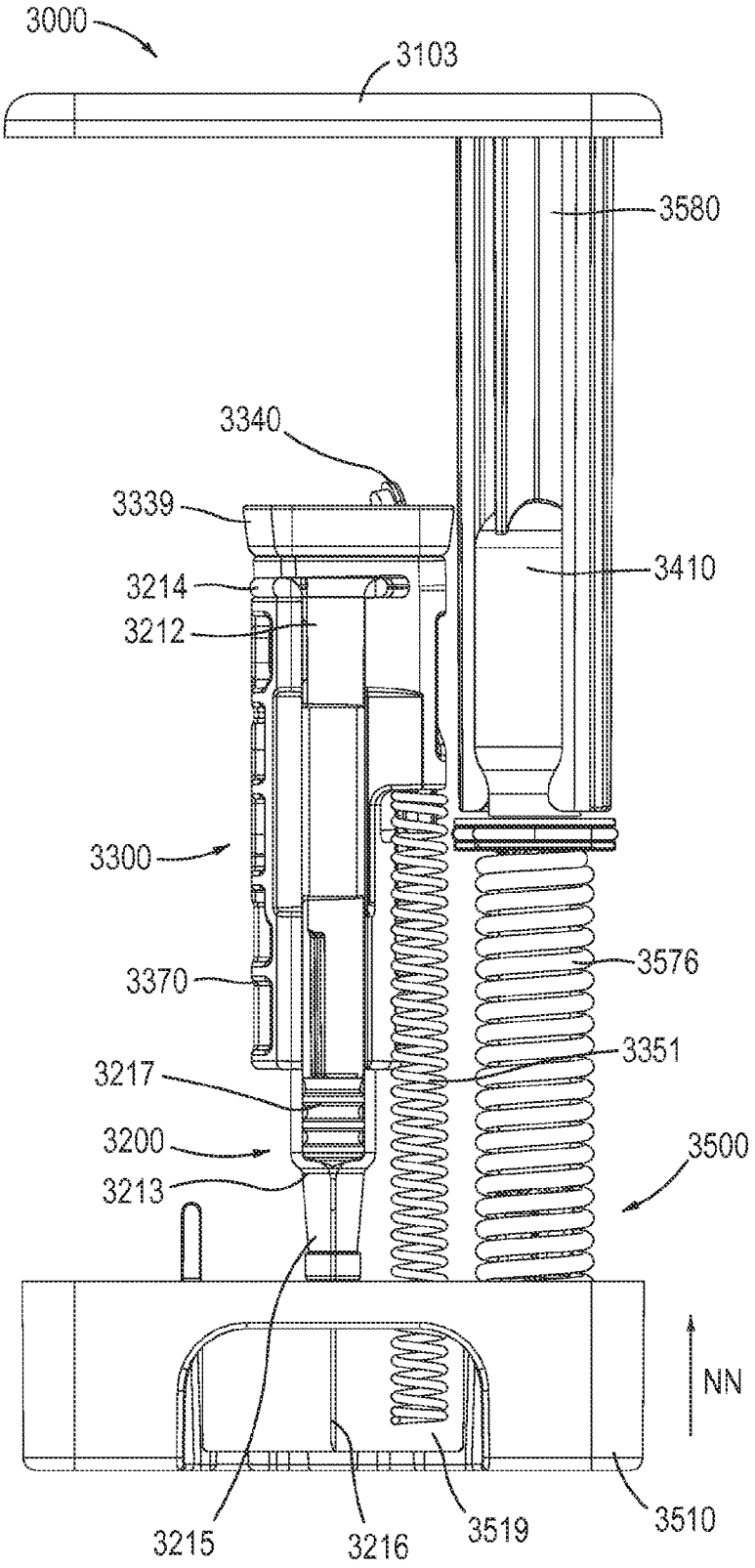
3000
3103
3580
3340
3339
3410
3214
3212
3300
3576
3370
3351
3217
3200
3500
3213
NN
3215
3216
3519
3510

FIG.54

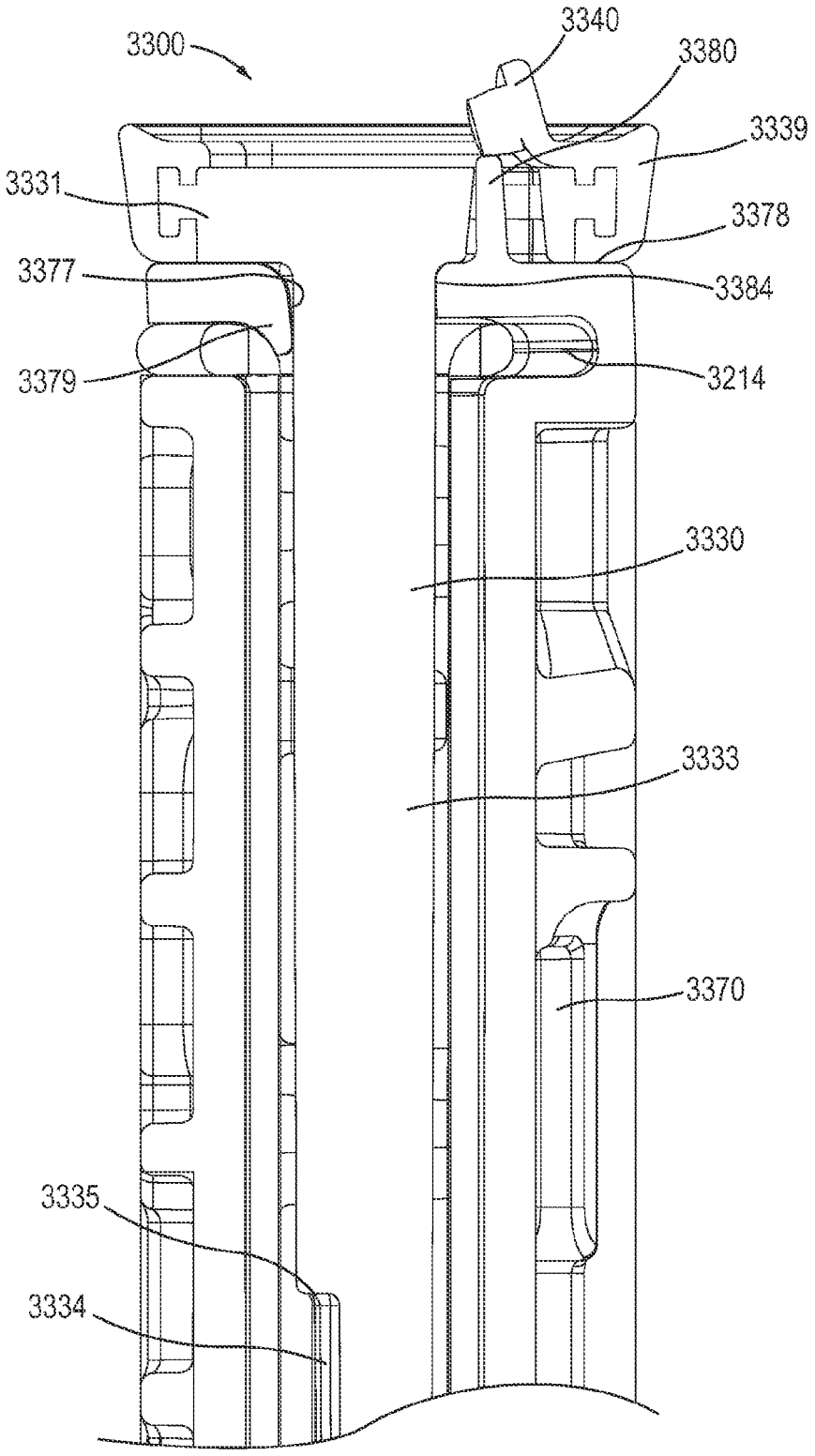
3300
3340
3380
3339
3331
3378
3377
3384
3379
3214
3330
3333
3370
3335
3334

FIG.55

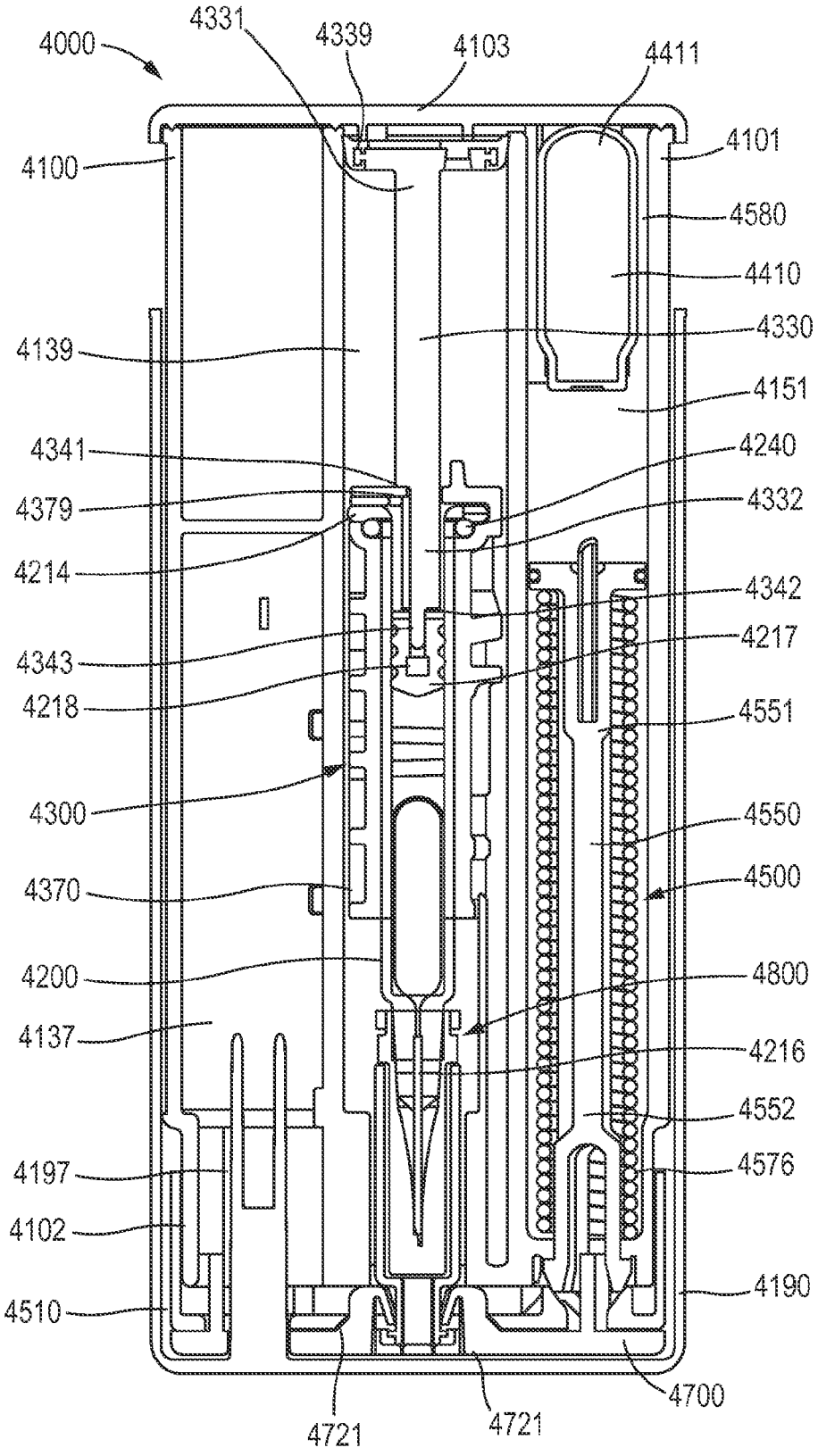
4000
4331
4339
4103
4411
4100
4101
4580
4410
4330
4139
4151
4341
4240
4379
4332
4214
4342
4217
4343
4218
4551
4300
4550
4370
4500
4200
4800
4137
4216
4552
4197
4576
4102
4190
4510
4700
4721
4721

FIG.56

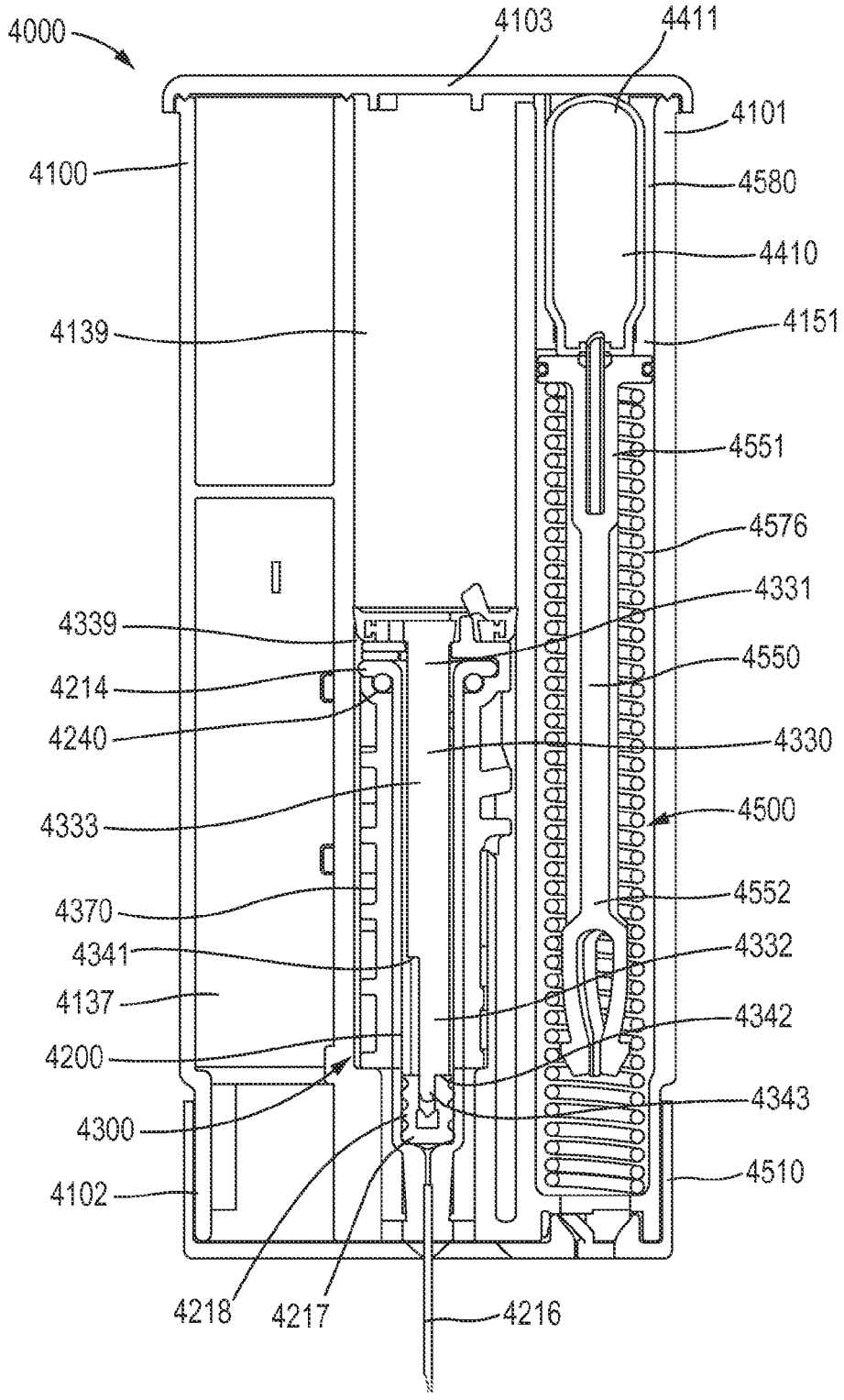
4000
4103
4411
4101
4100
4580
4410
4139
4151
4551
4576
4331
4339
4550
4214
4240
4330
4333
4500
4370
4552
4341
4332
4137
4342
4200
4343
4300
4510
4102
4218
4217
4216

FIG.57

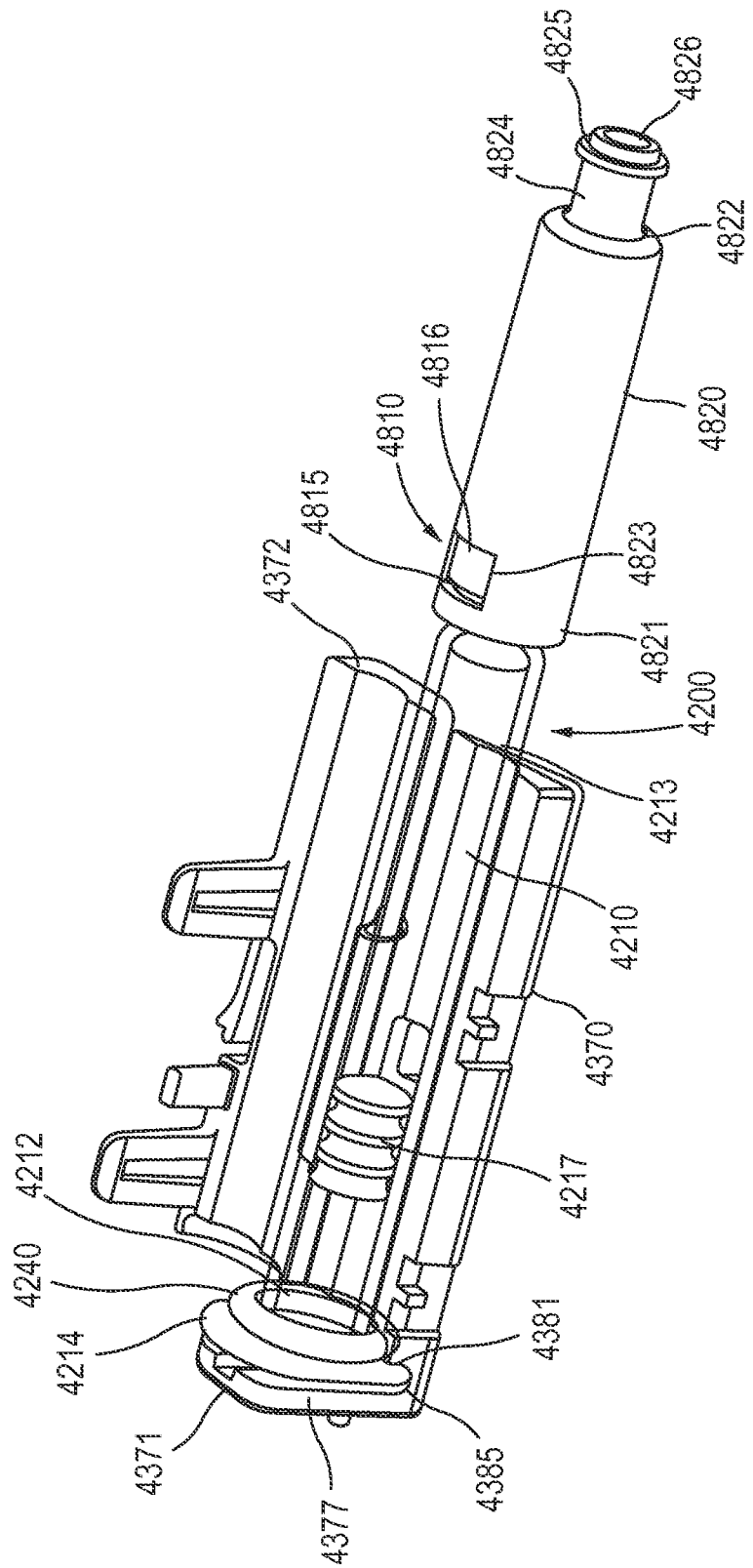
4825
4826
4824
4822
4816
4810
4820
4815
4823
4372
4821
4200
4213
4210
4370
4212
4217
4240
4214
4381
4371
4385
4377

FIG.58

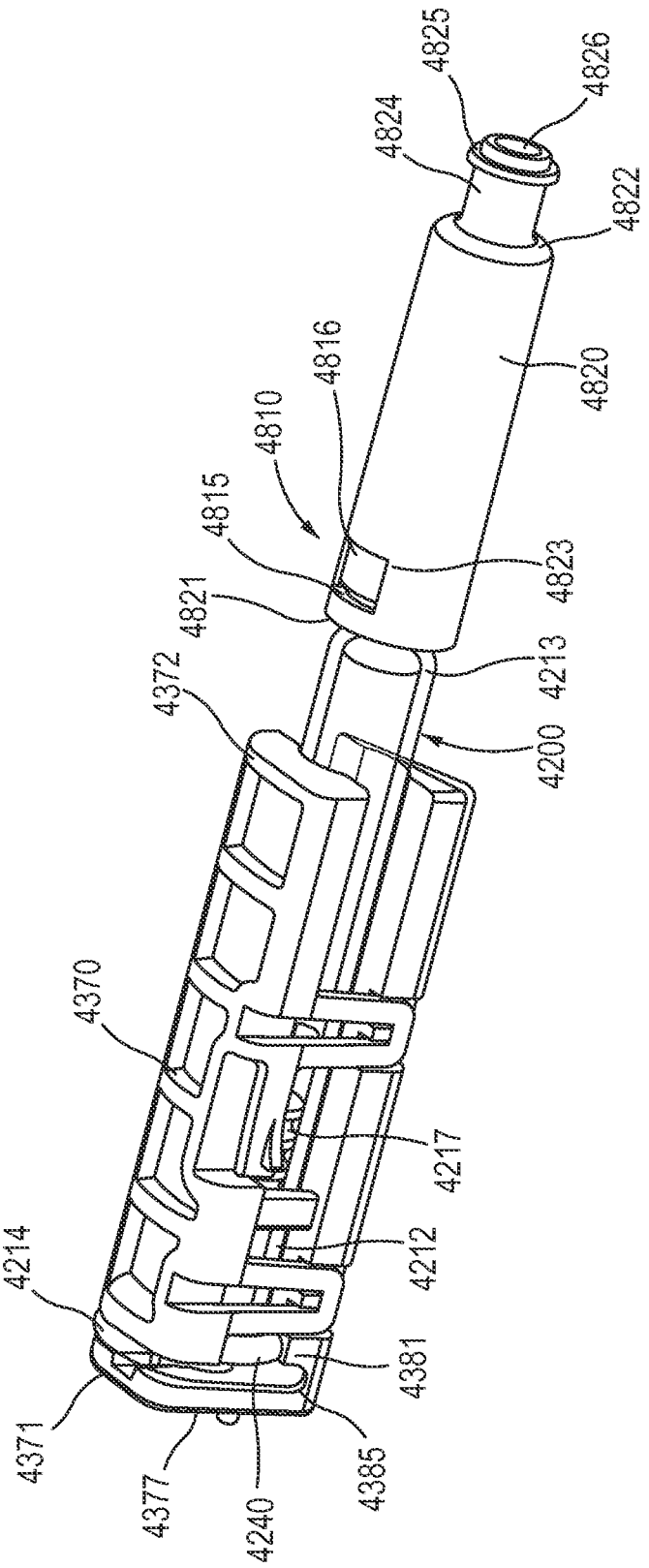
4825
4826
4824
4822
4816
4820
4810
4815
4823
4821
4213
4372
4200
4370
4217
4214
4212
4381
4371
4377
4240
4385

FIG.59

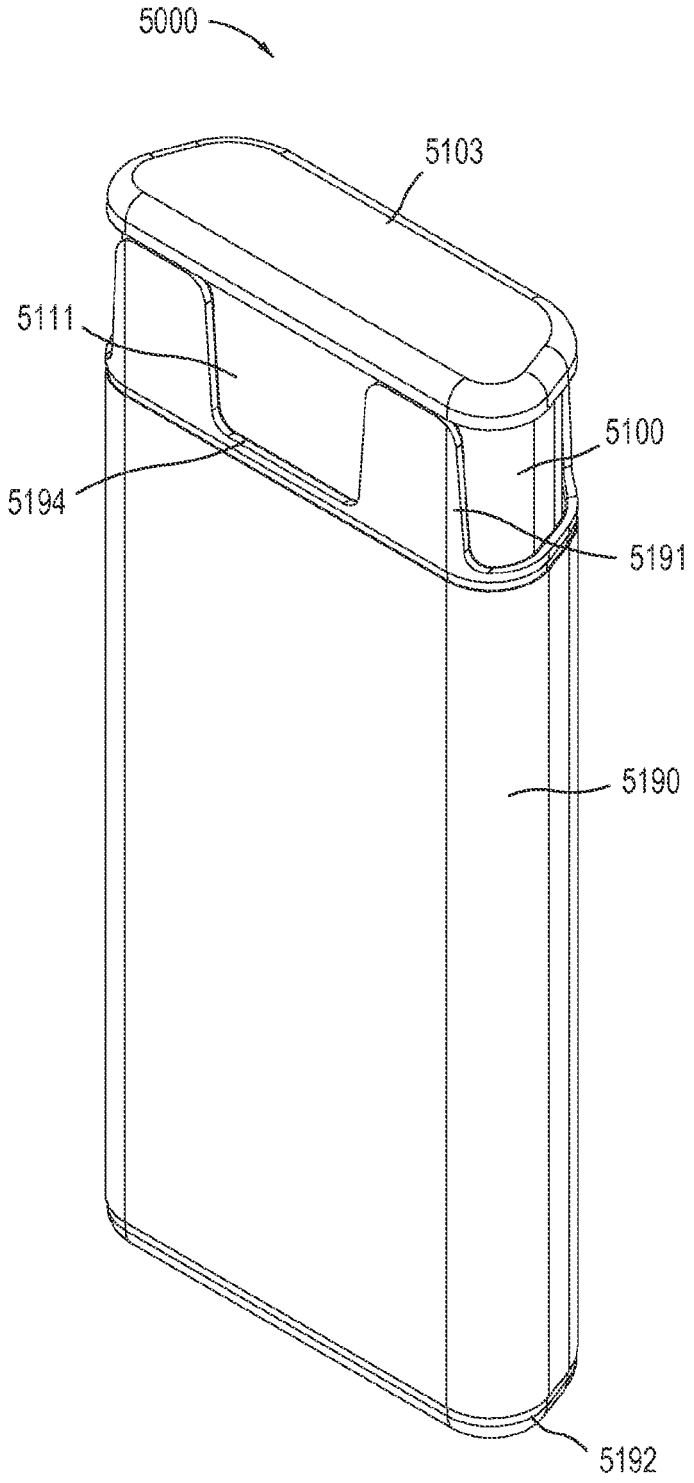

FIG.60

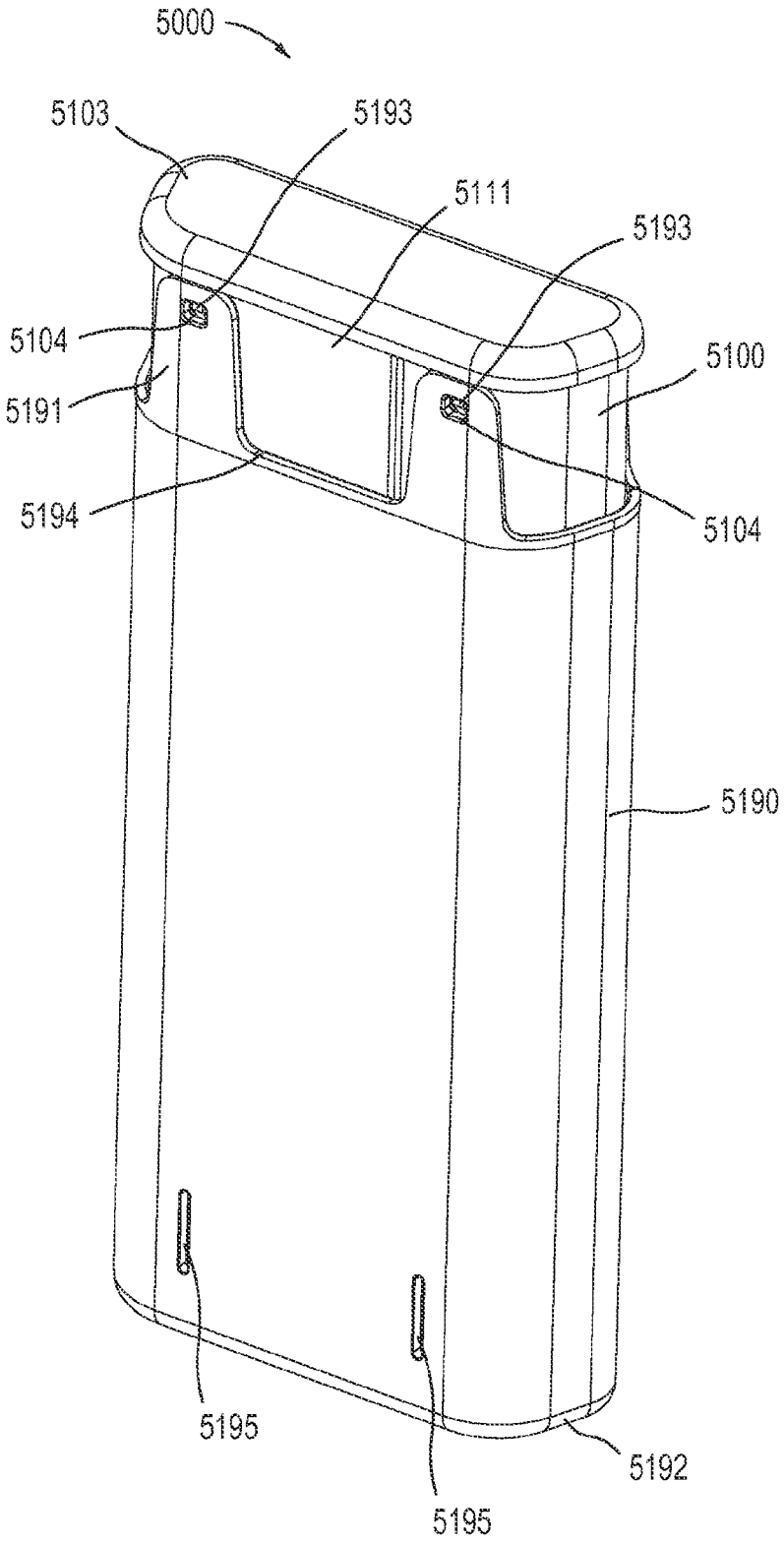
5000
5103
5193
5111
5193
5104
5100
5191
5194
5104
5190
5195
5192
5195

FIG.61

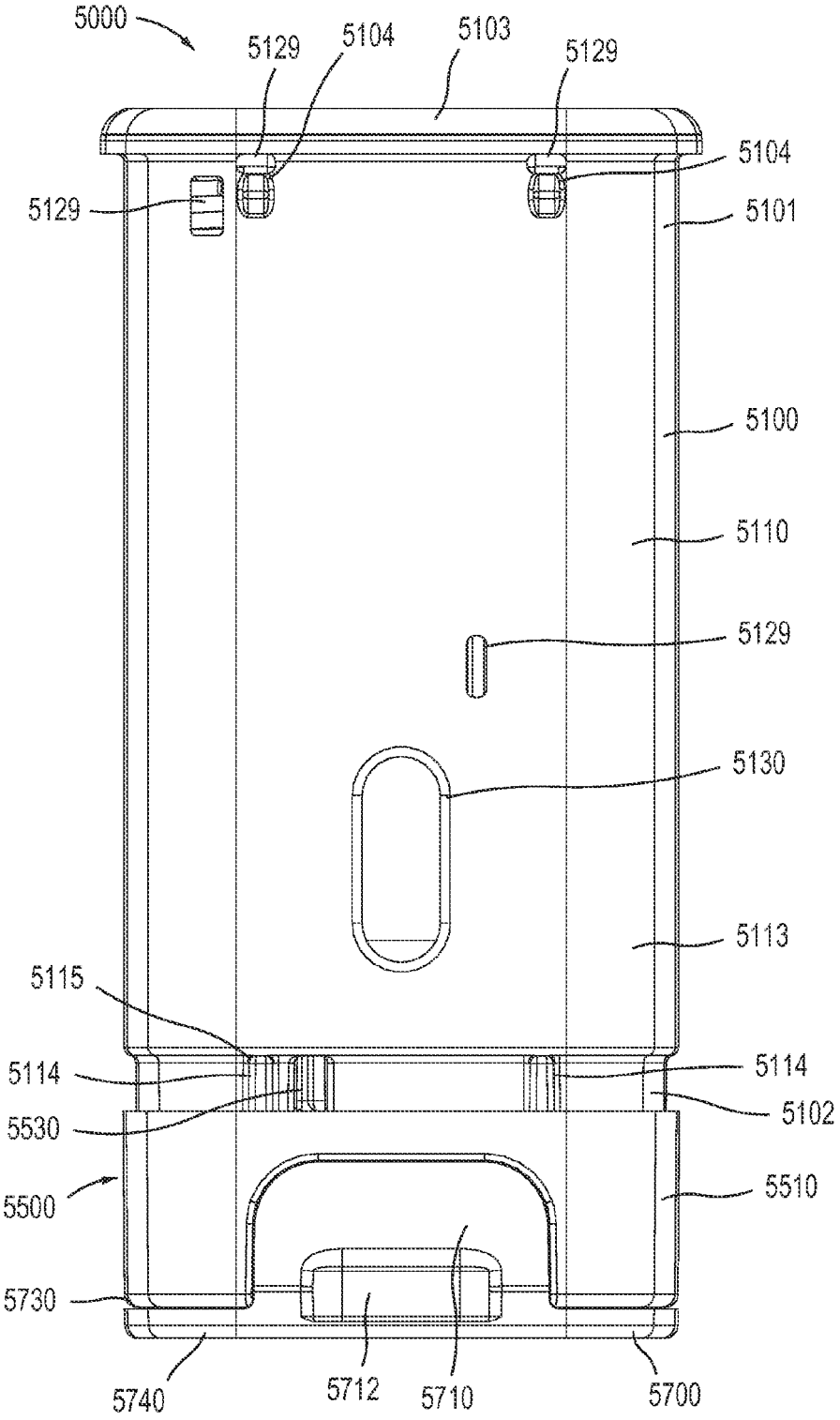
5000
5129
5104
5103
5129
5104
5129
5101
5100
5110
5129
5130
5113
5115
5114
5114
5530
5102
5500
5510
5730
5740
5712
5710
5700

FIG.62

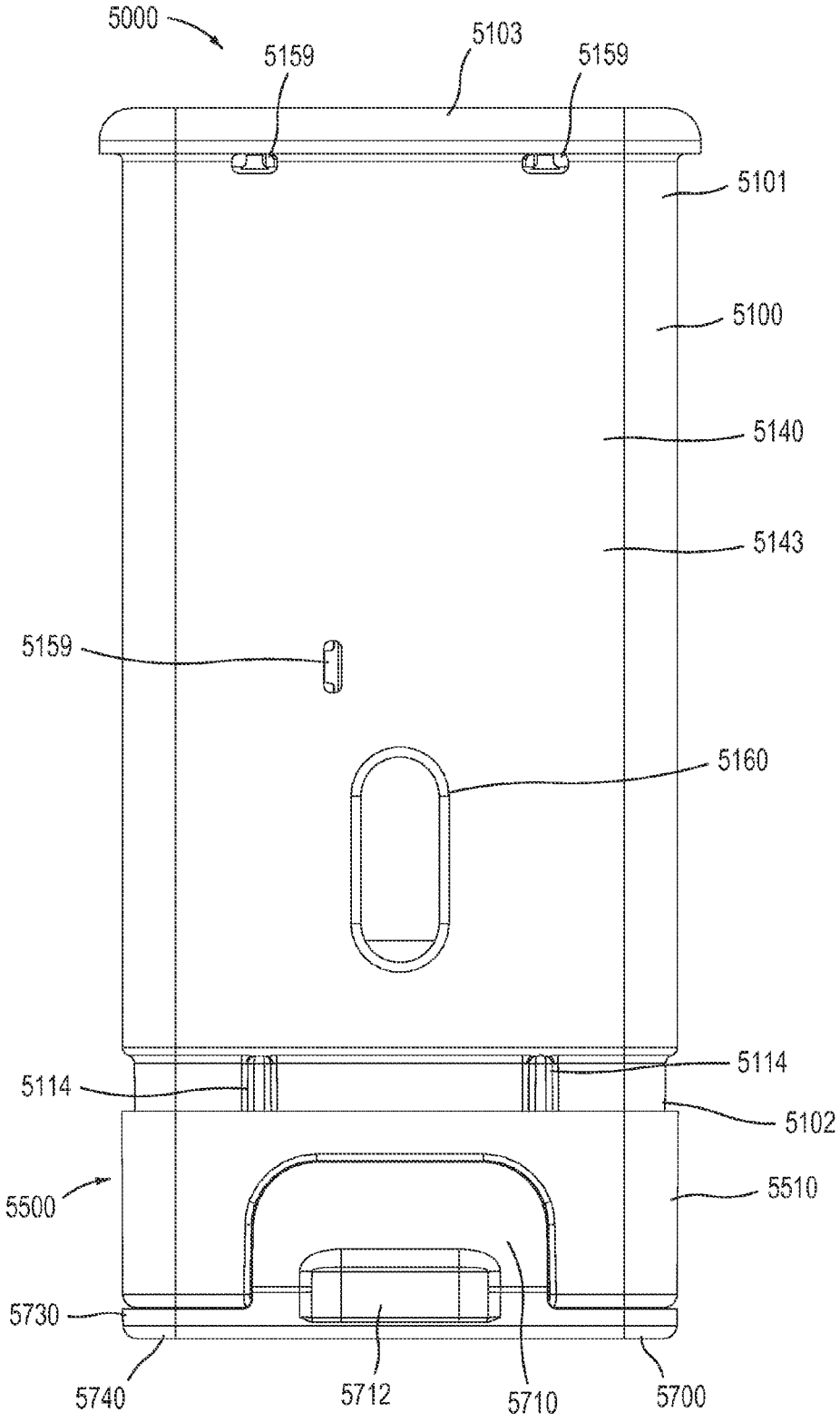
5000
5159
5103
5159
5101
5100
5140
5143
5159
5160
5114
5114
5102
5500
5510
5730
5740
5712
5710
5700

FIG.63

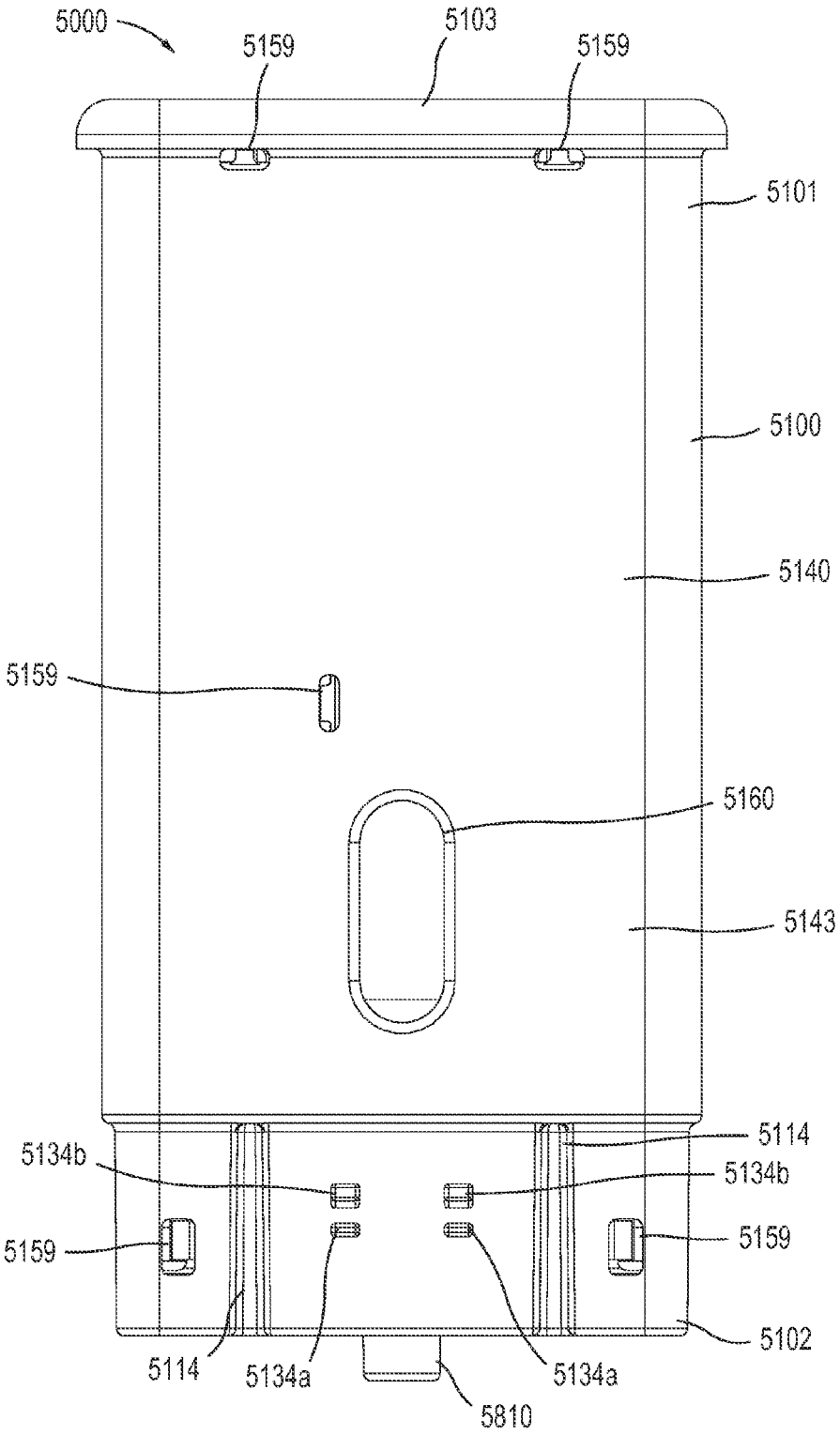
5000
5159
5103
5159
5101
5100
5140
5159
5160
5143
5114
5134b
5134b
5159
5159
5102
5114
5134a
5134a
5810

FIG.64

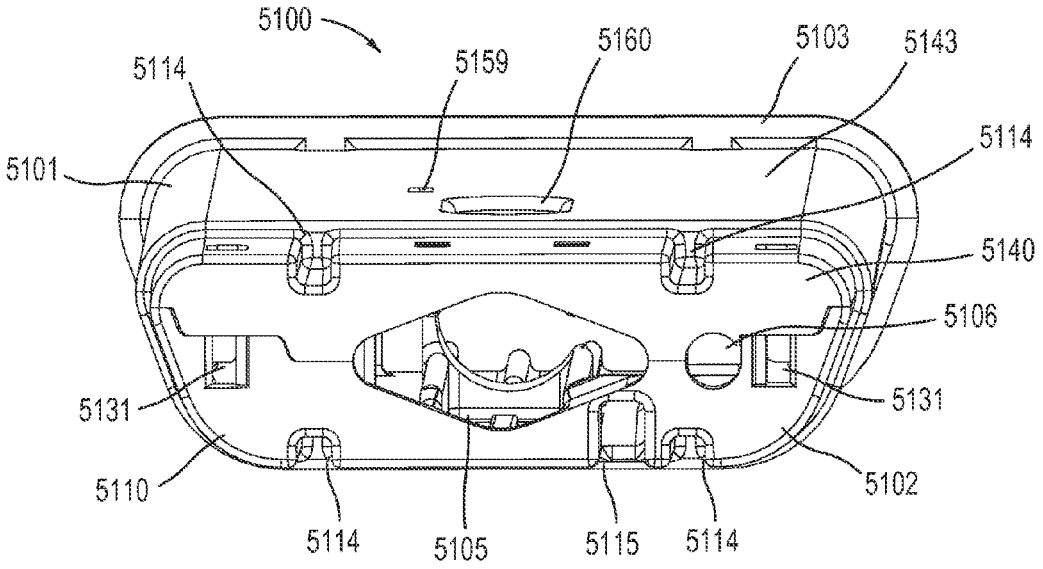
5100
5159
5160
5103
5143
5114
5101
5114
5140
5106
5131
5131
5110
5102
5114
5105
5115
5114

FIG.65

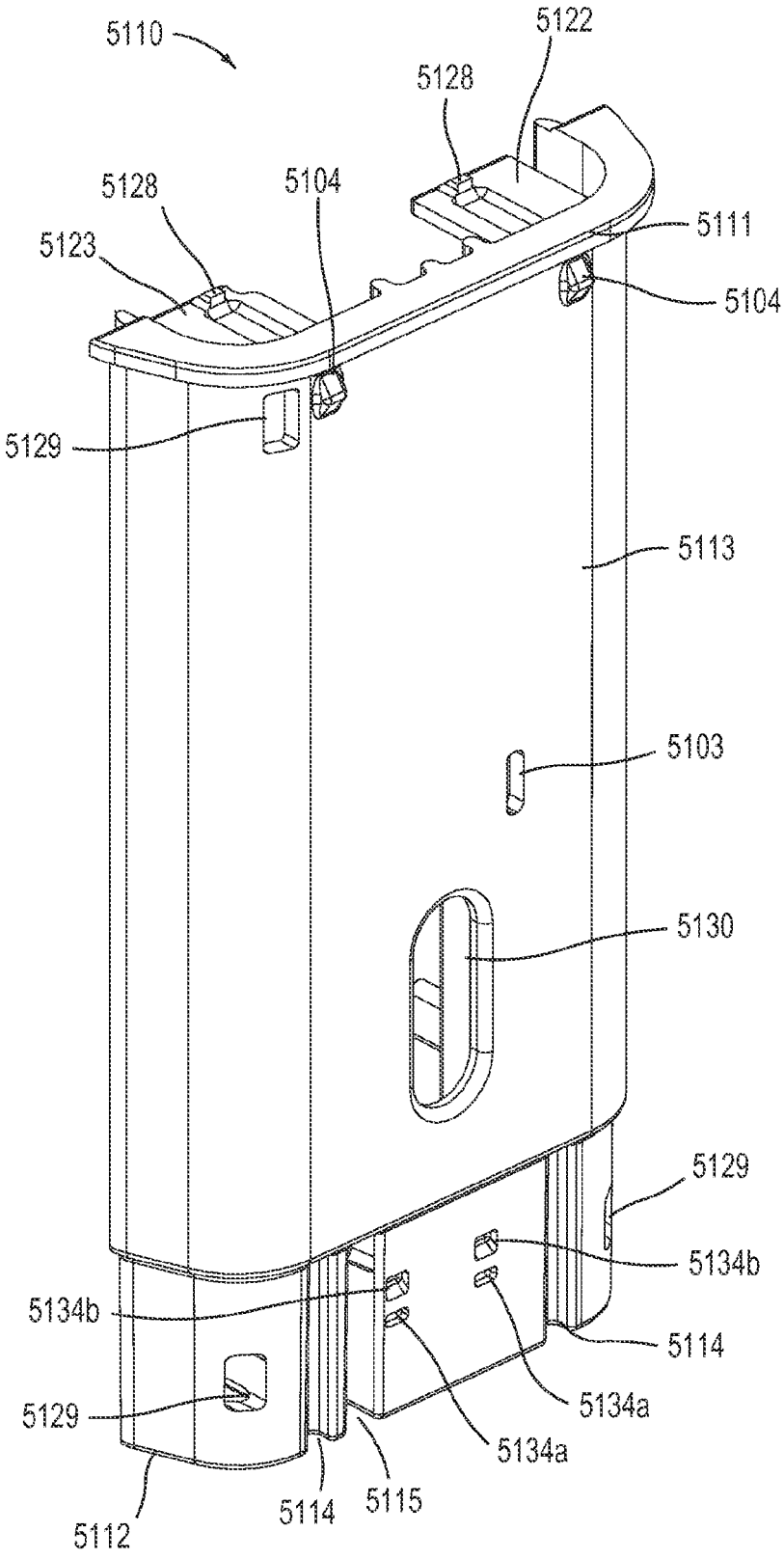
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FIG.66

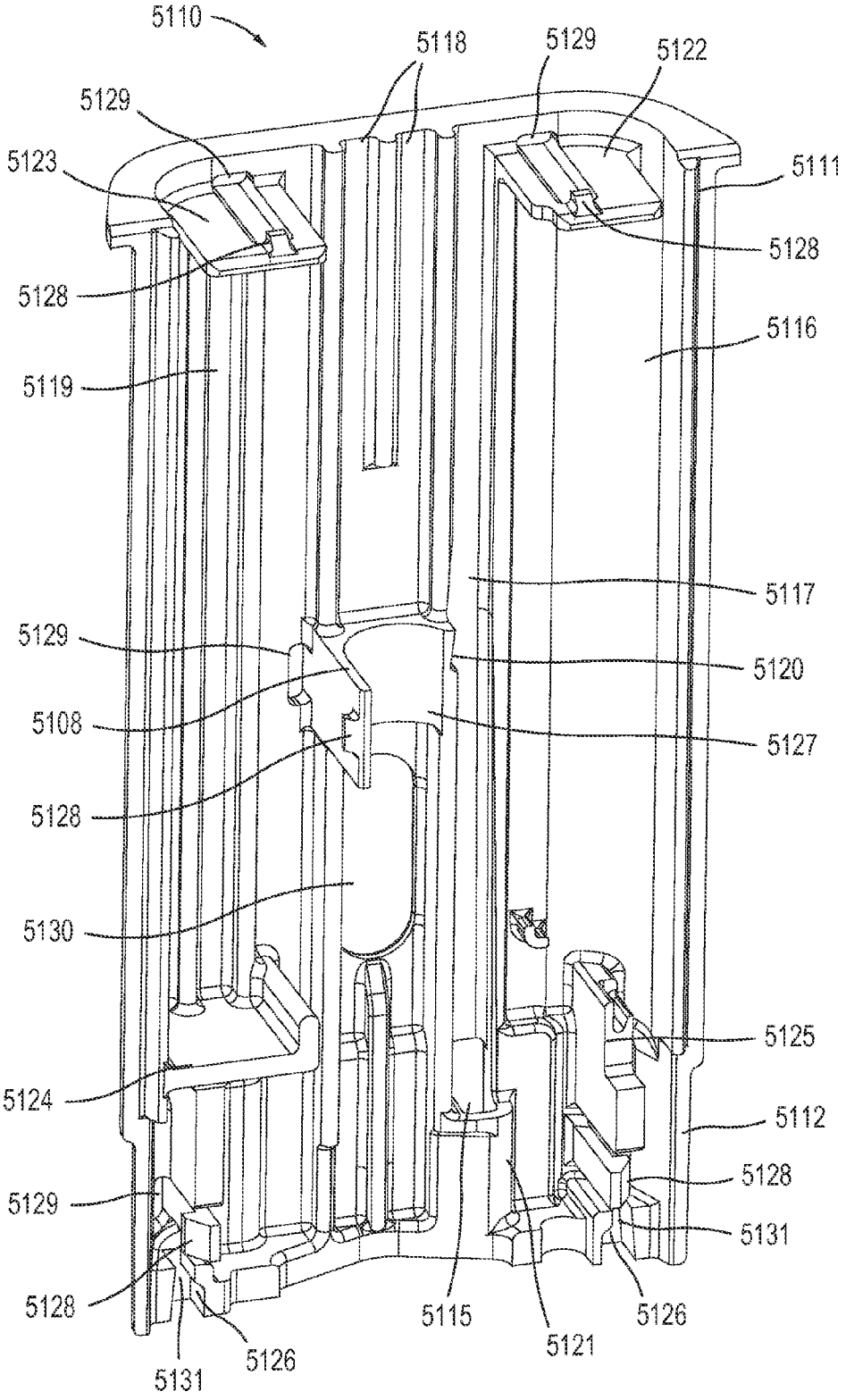
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FIG.67

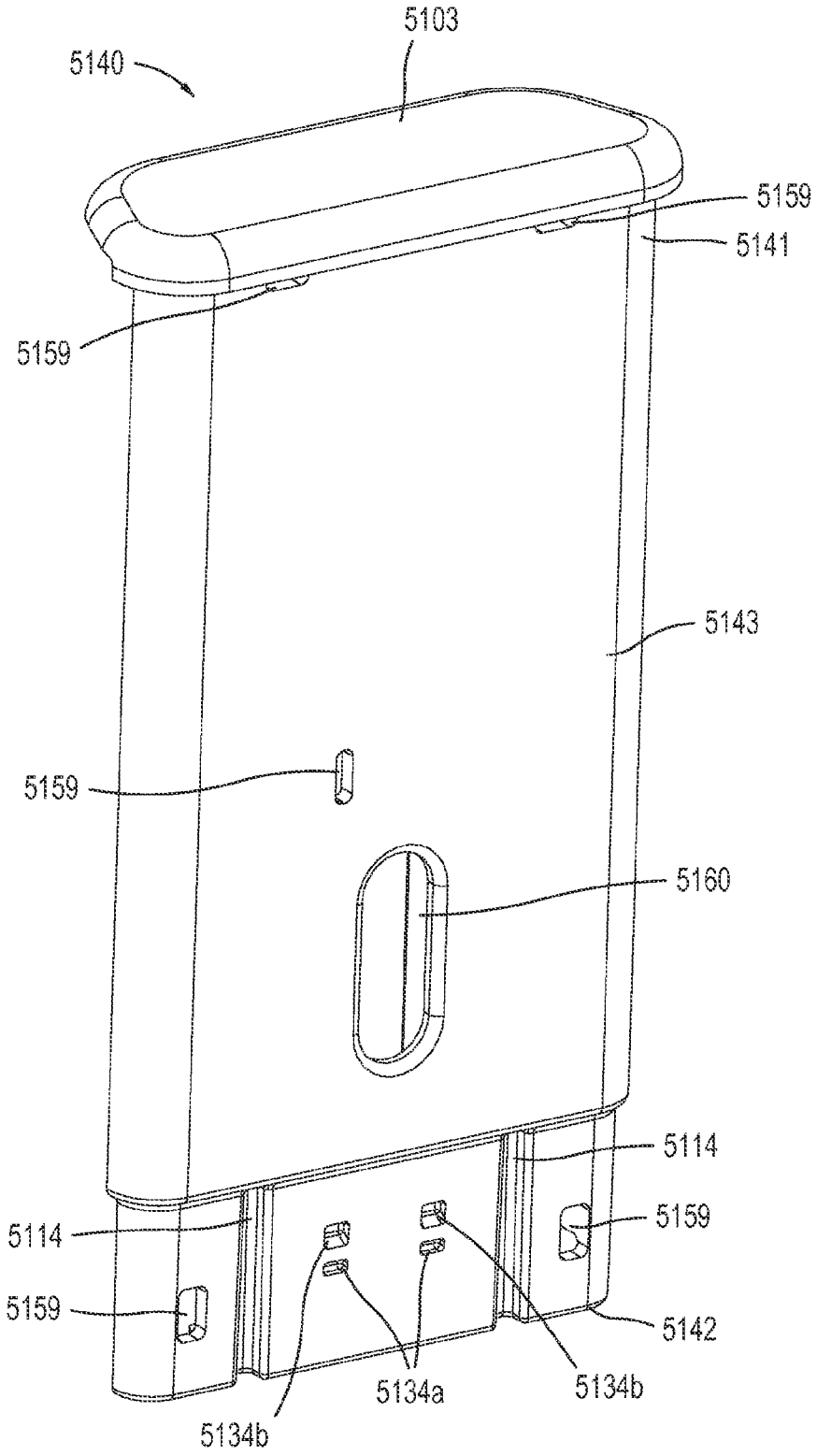
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FIG.68

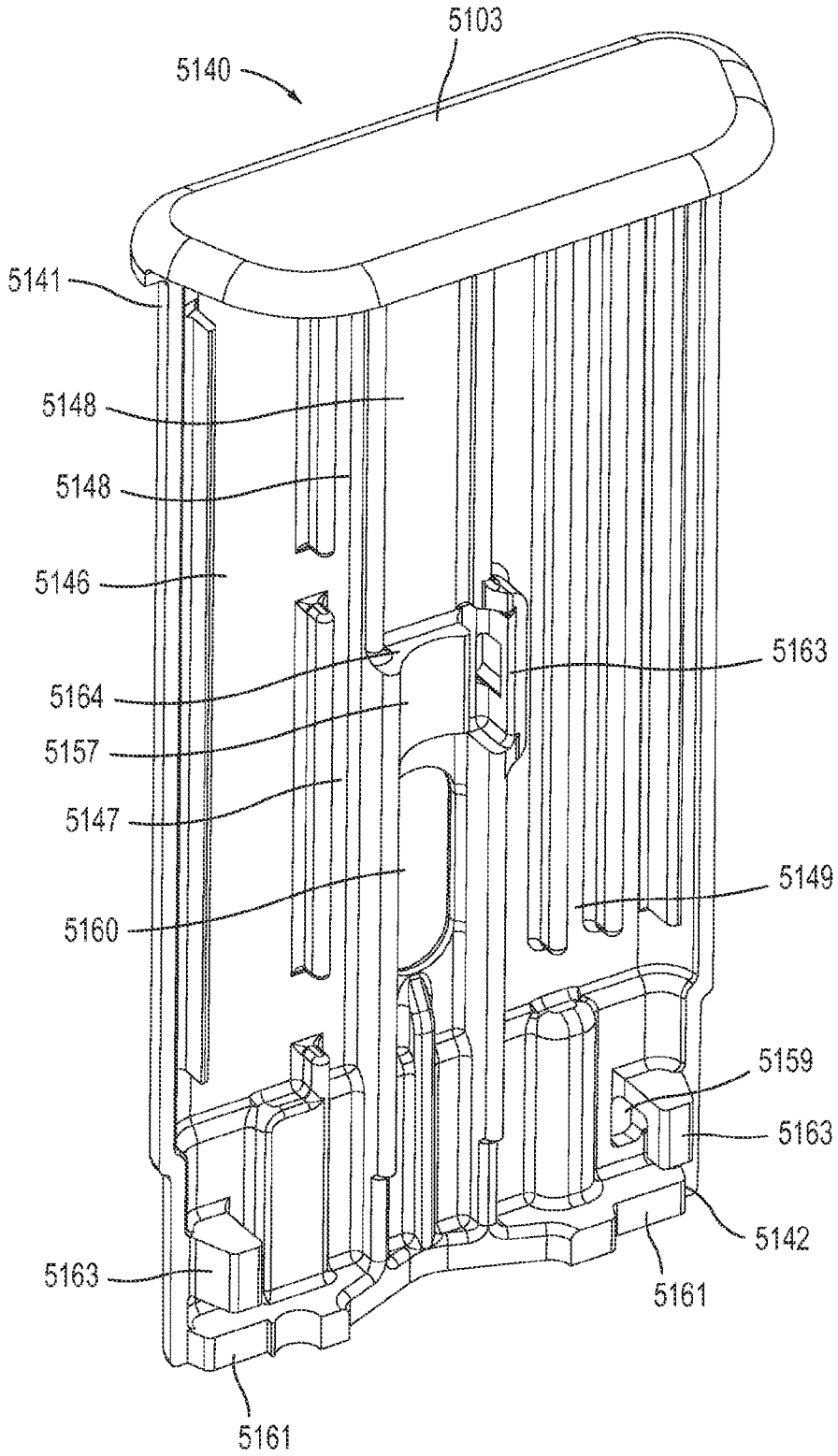
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FIG.69

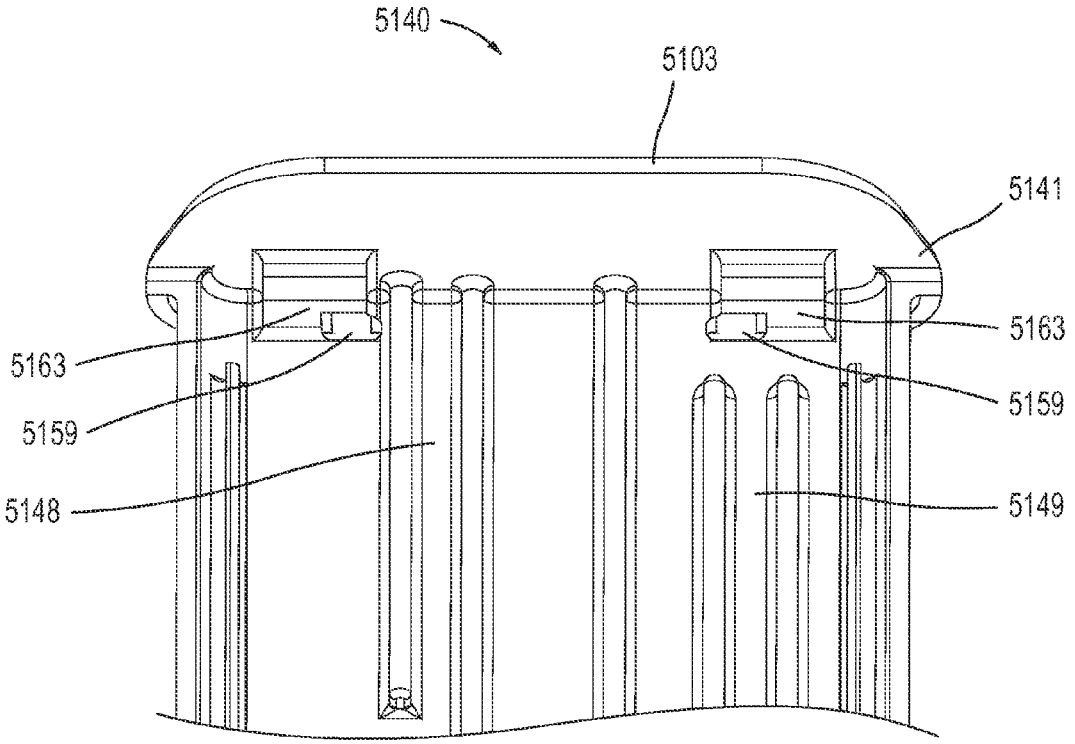

FIG.70

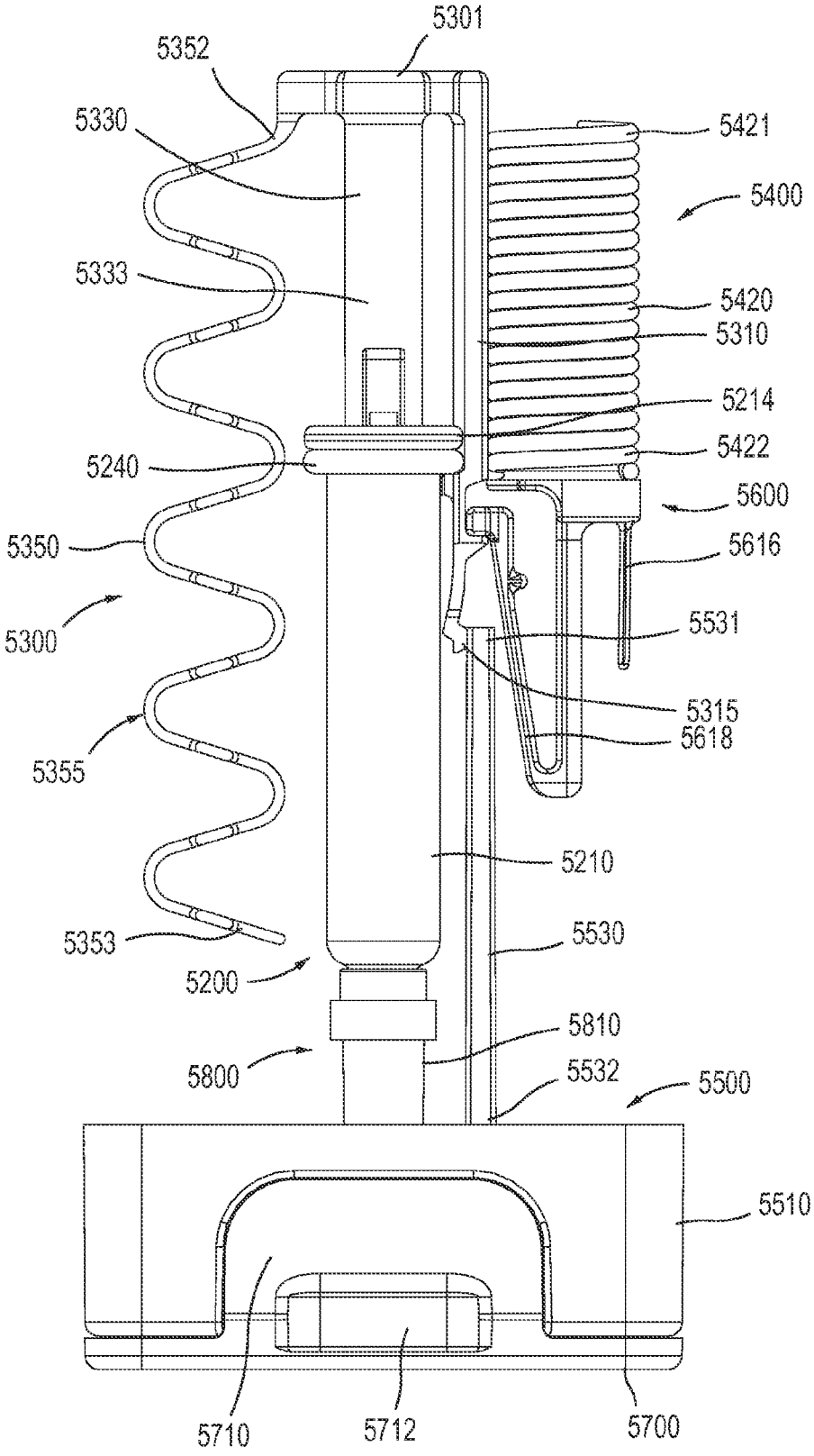
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FIG.71

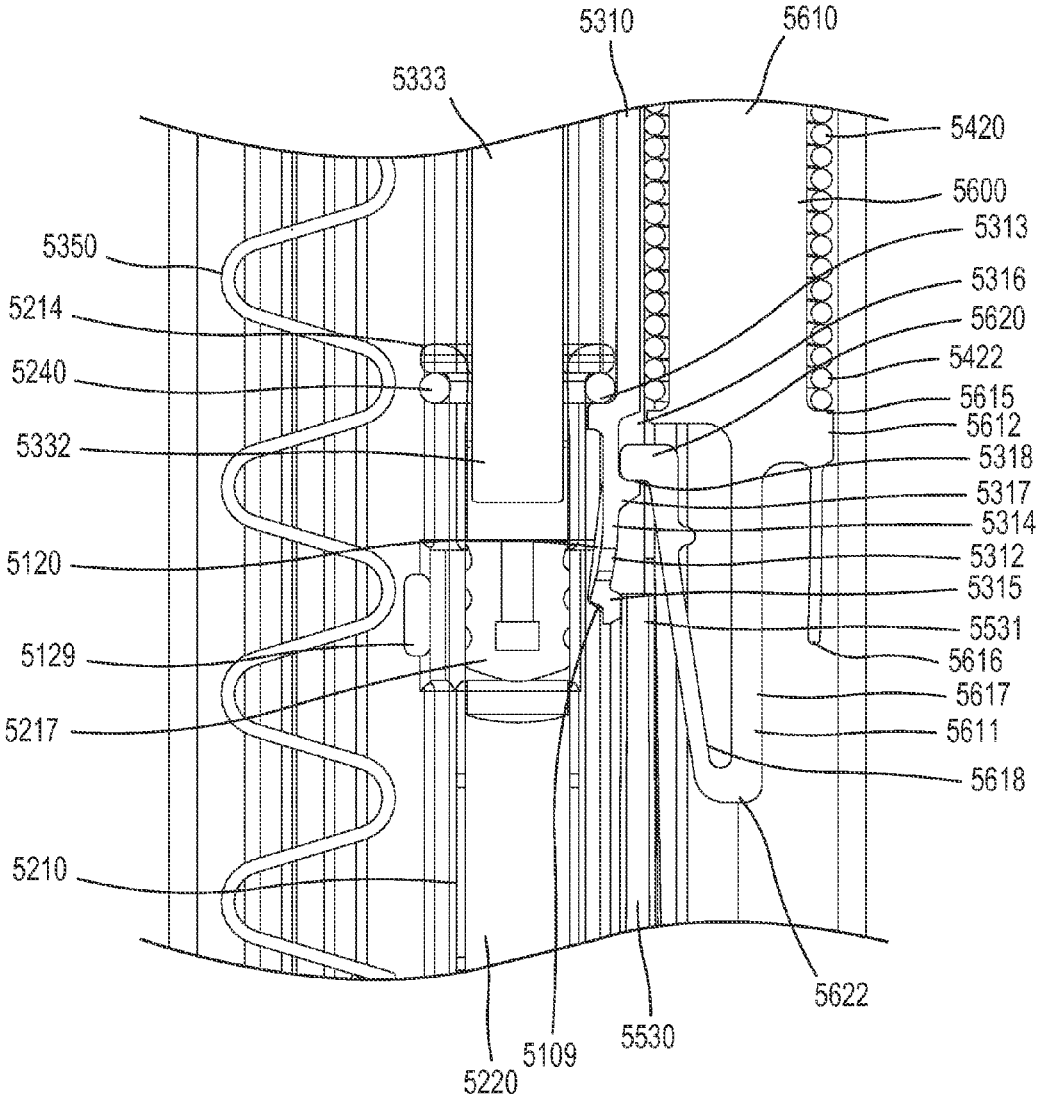
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FIG.72

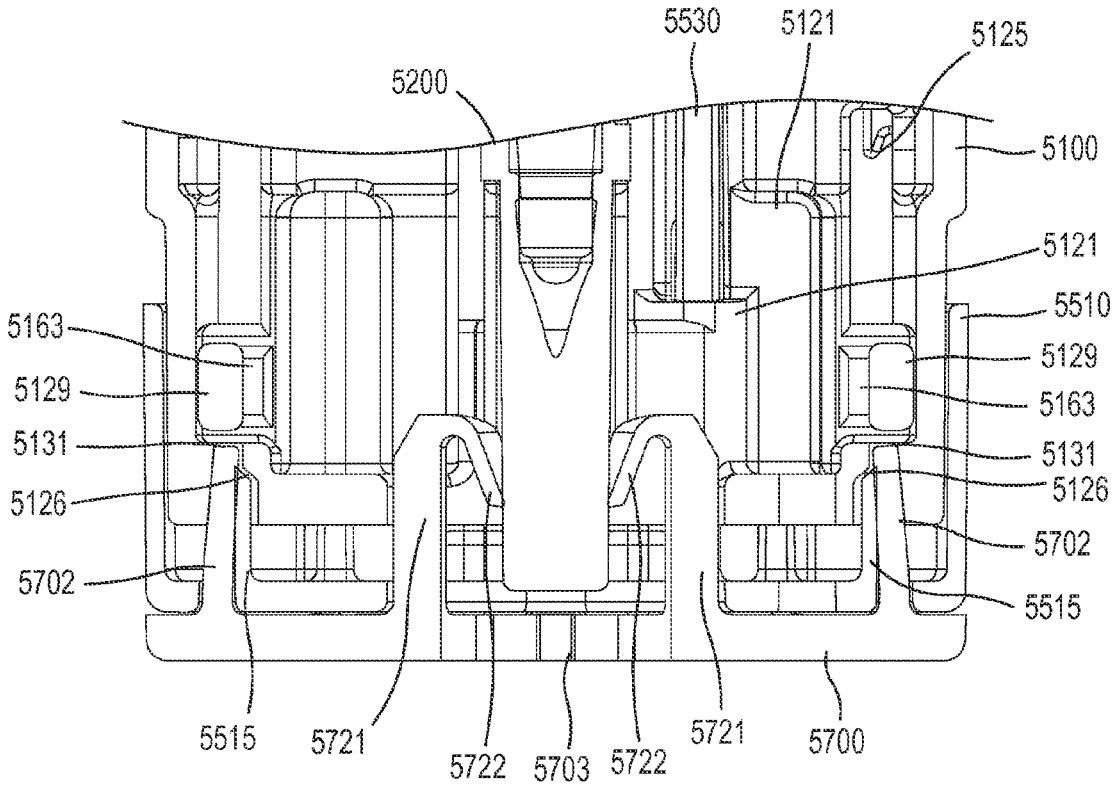
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FIG.73

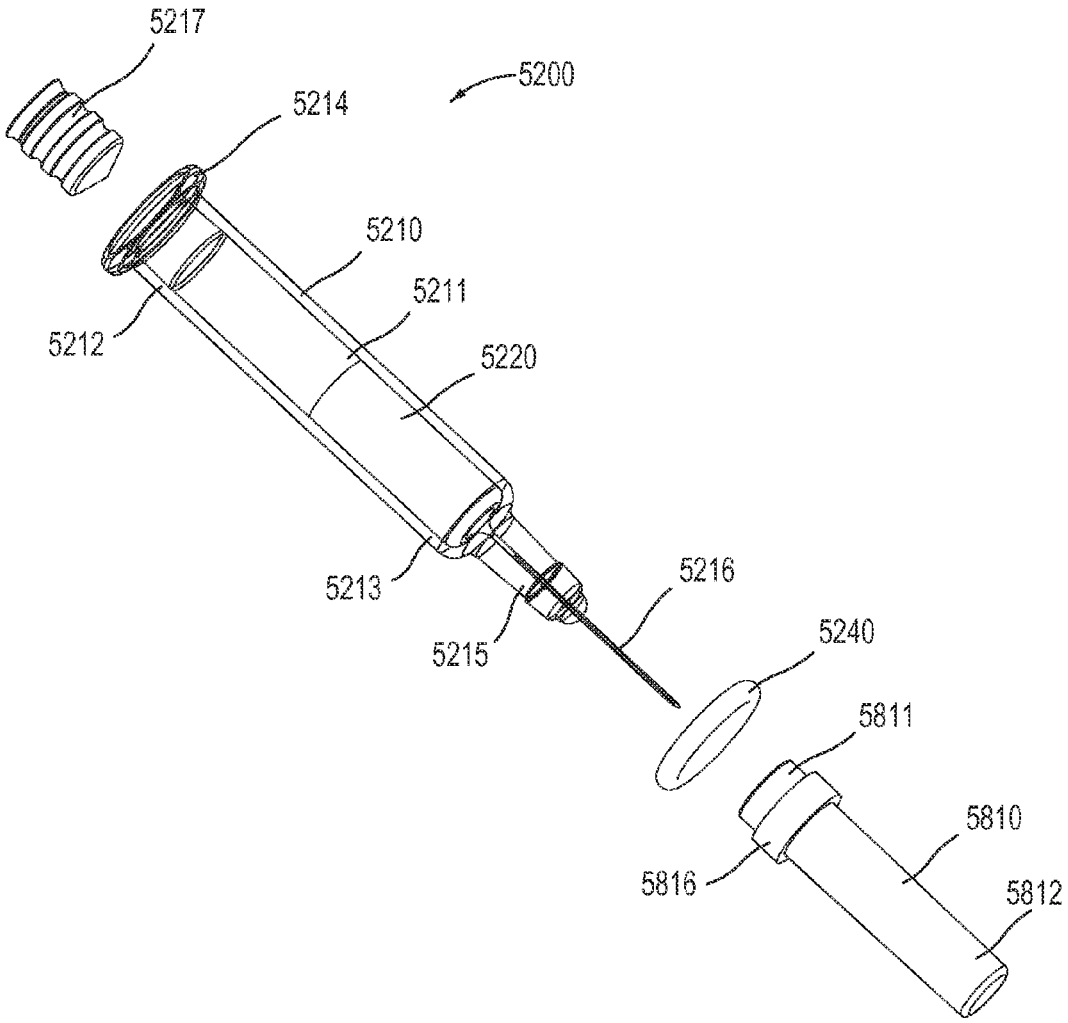
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FIG.74

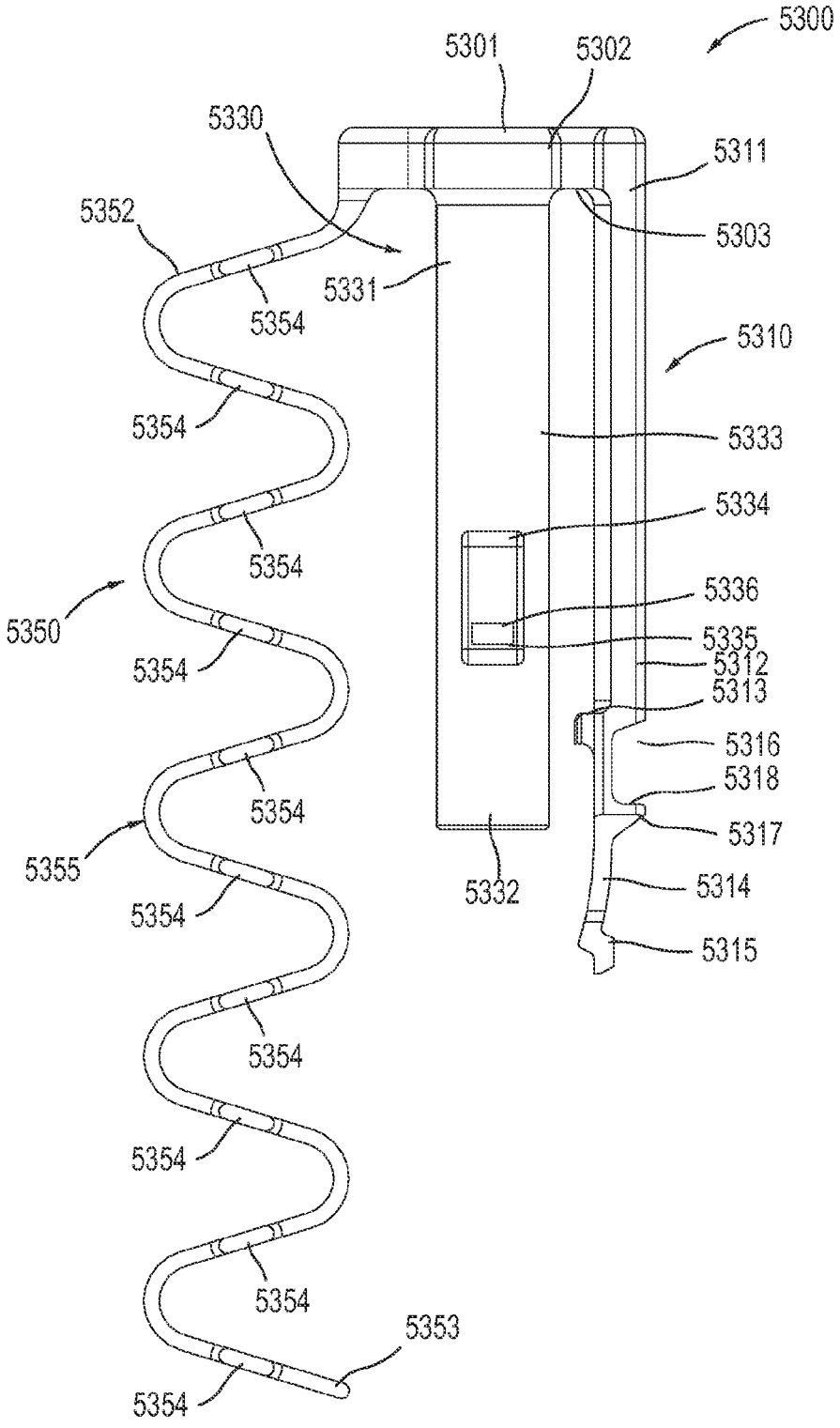
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FIG.75

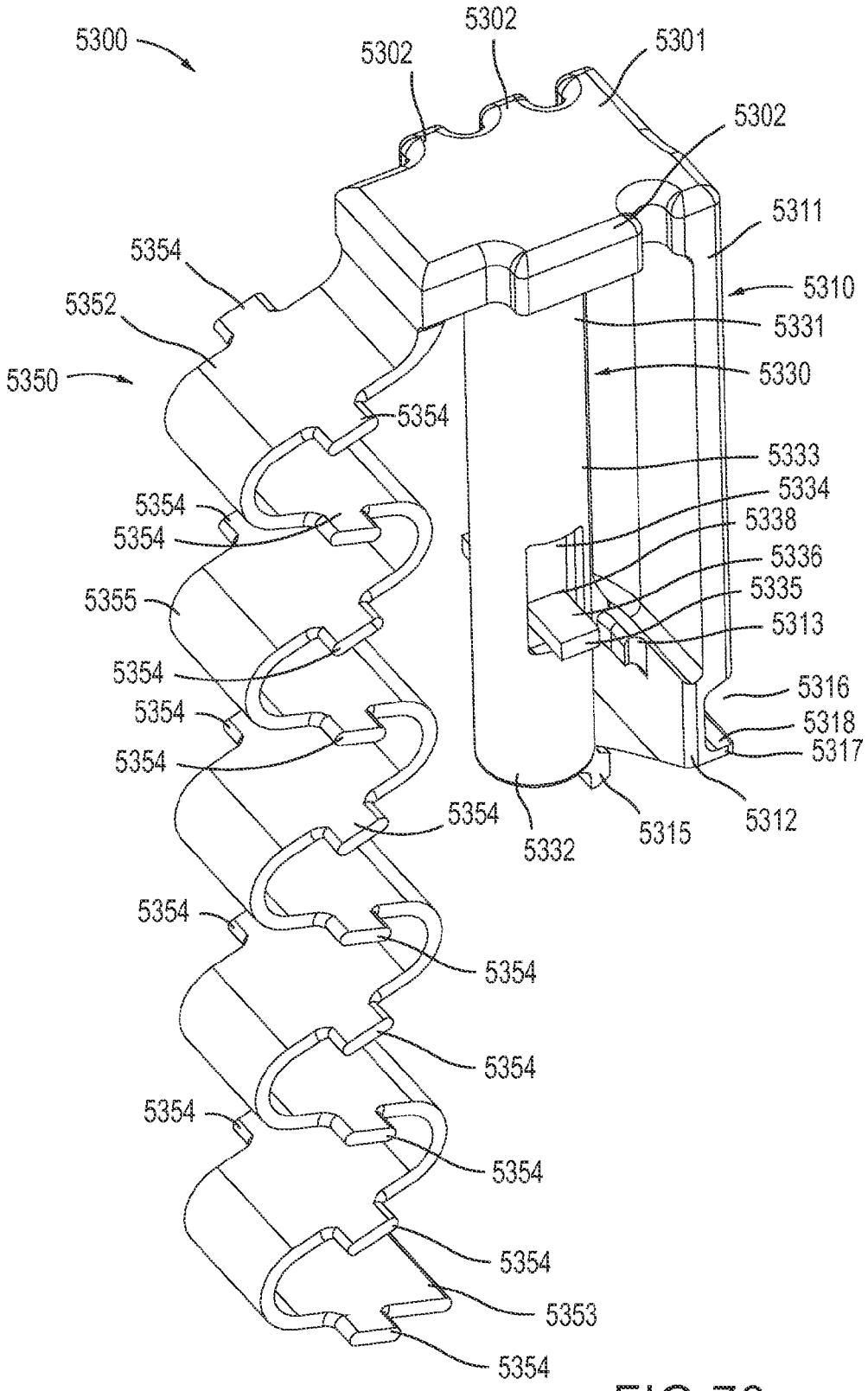
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FIG.76

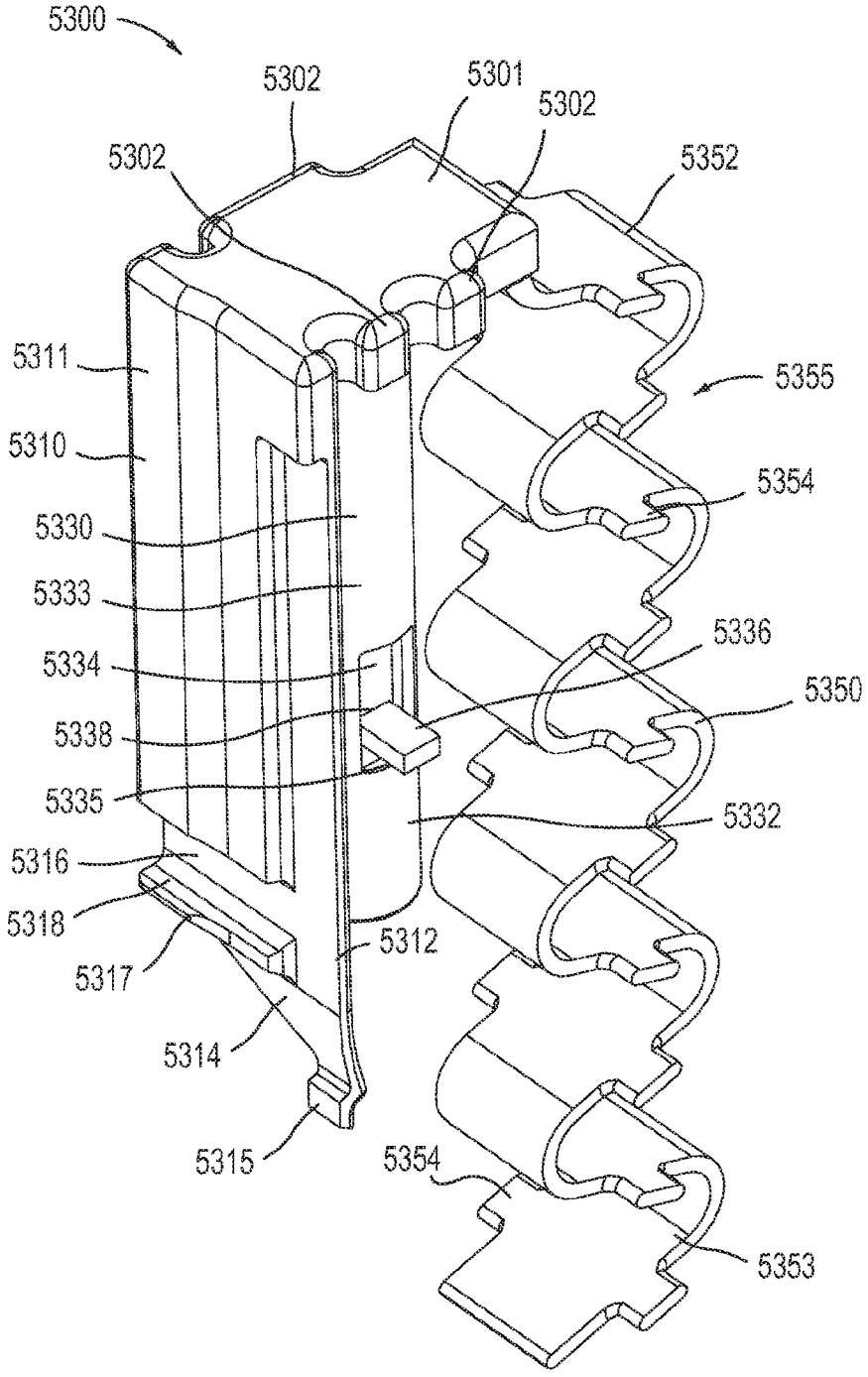
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FIG.77

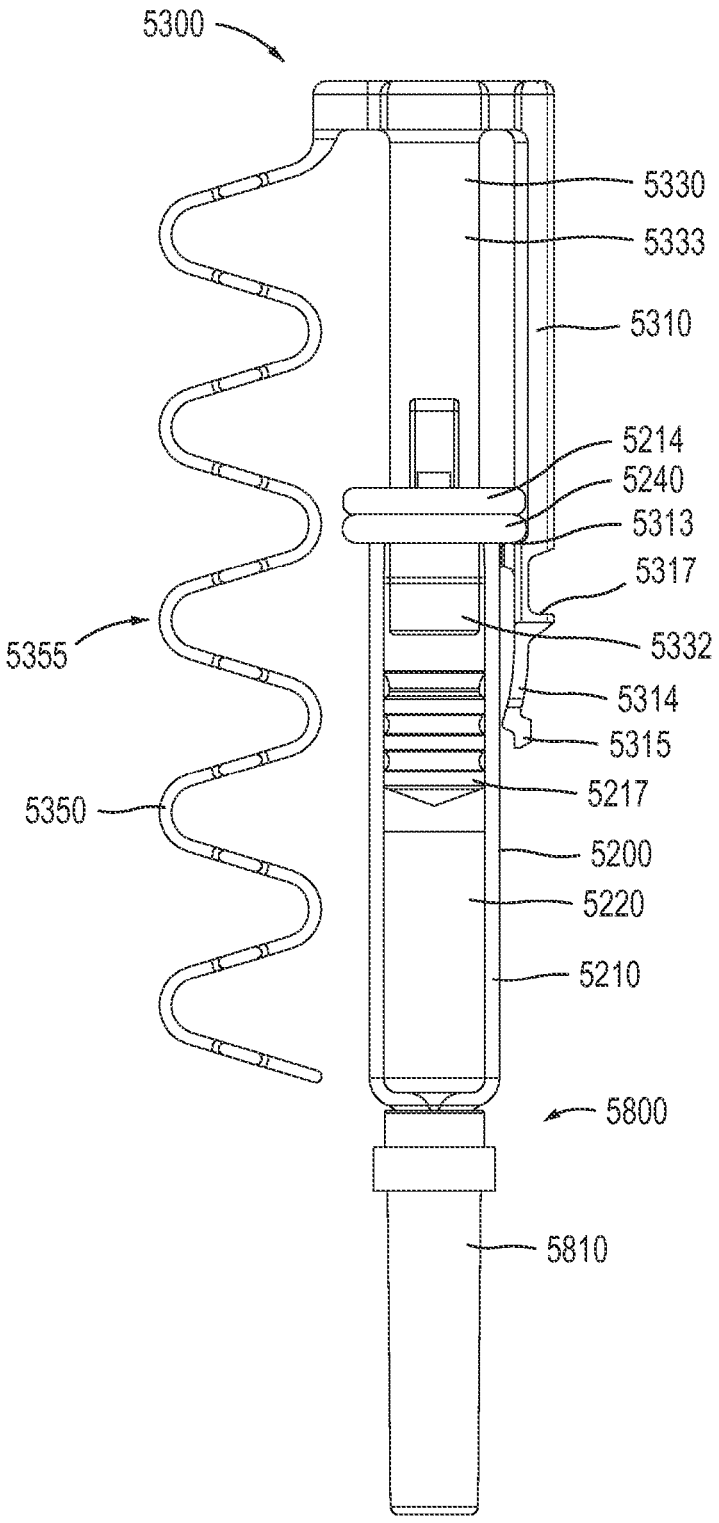
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FIG.78

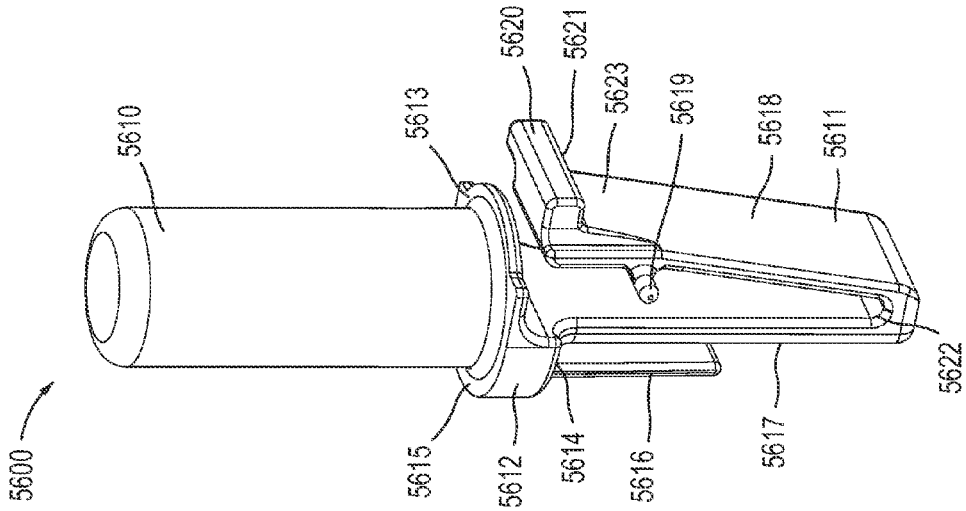
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FIG.80

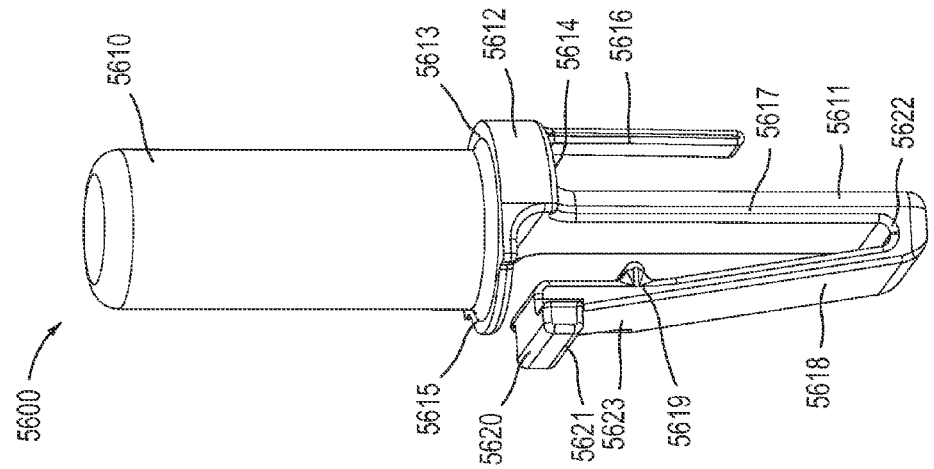
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FIG.79

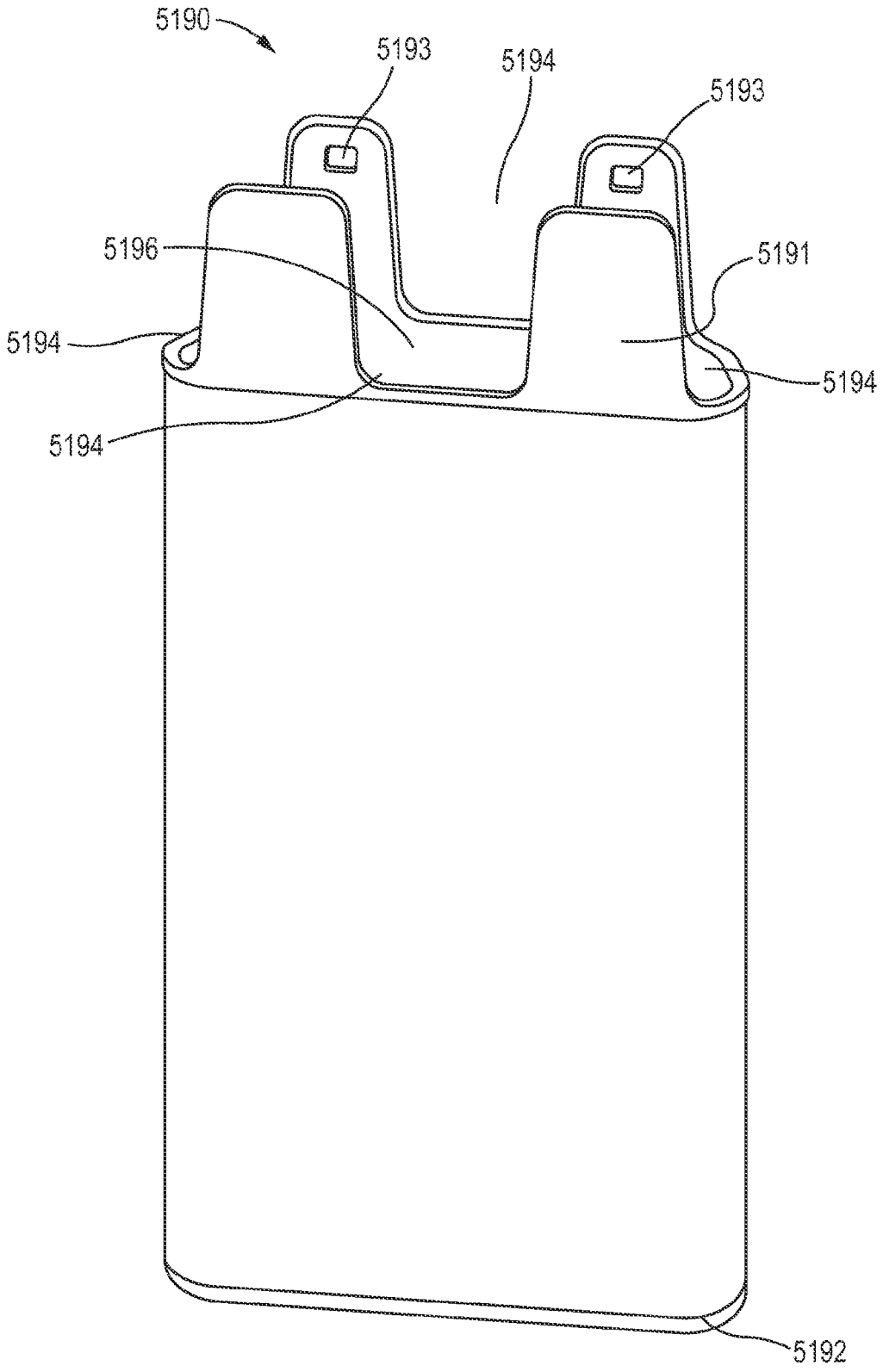

FIG.81

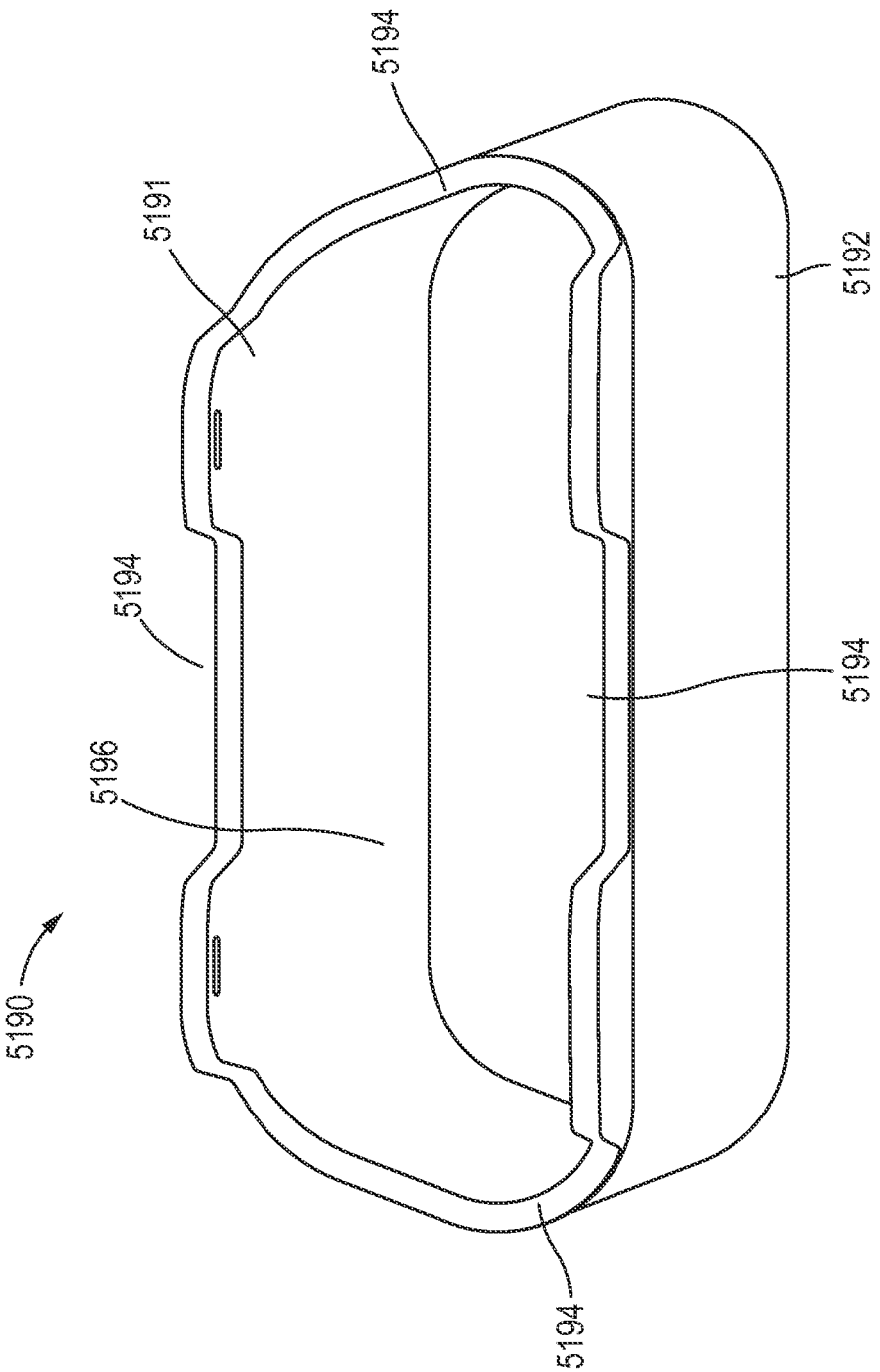

FIG.82

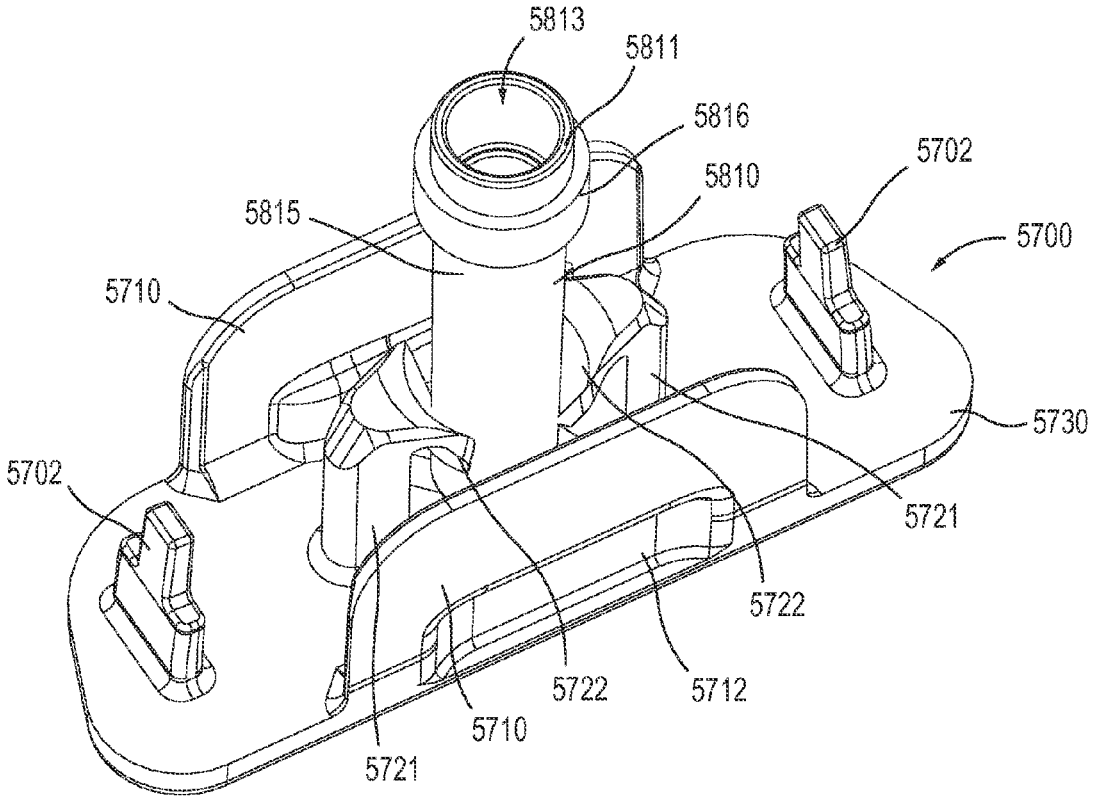
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FIG.83

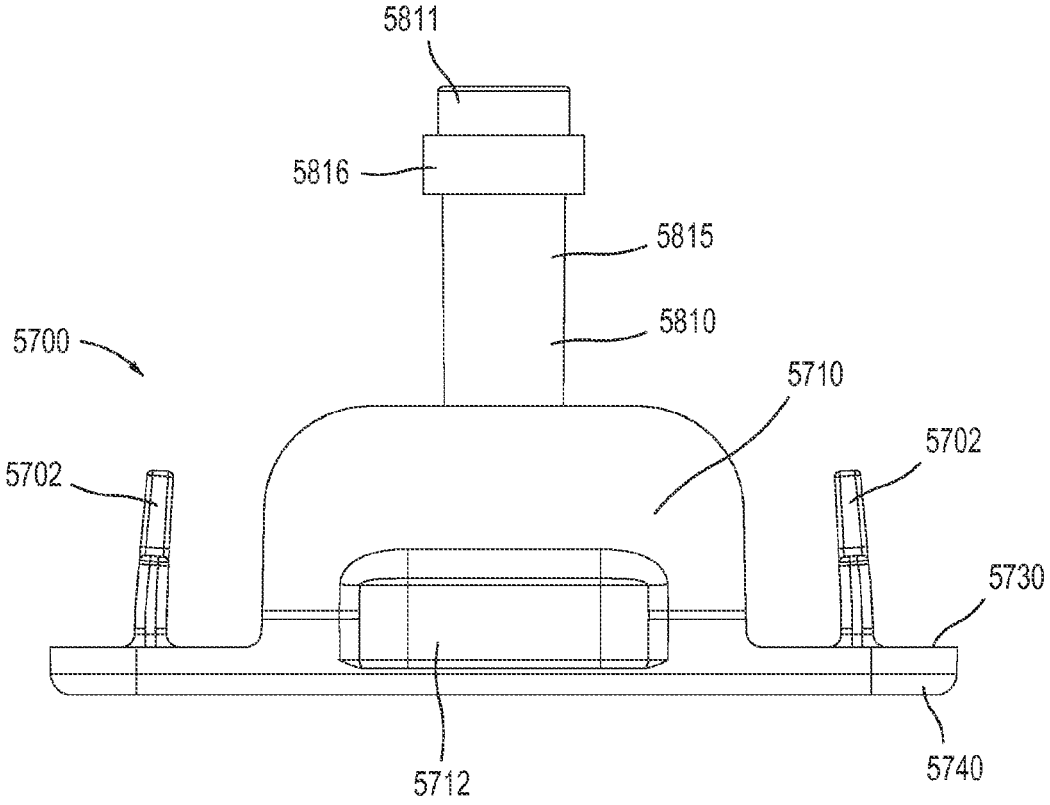

FIG.84

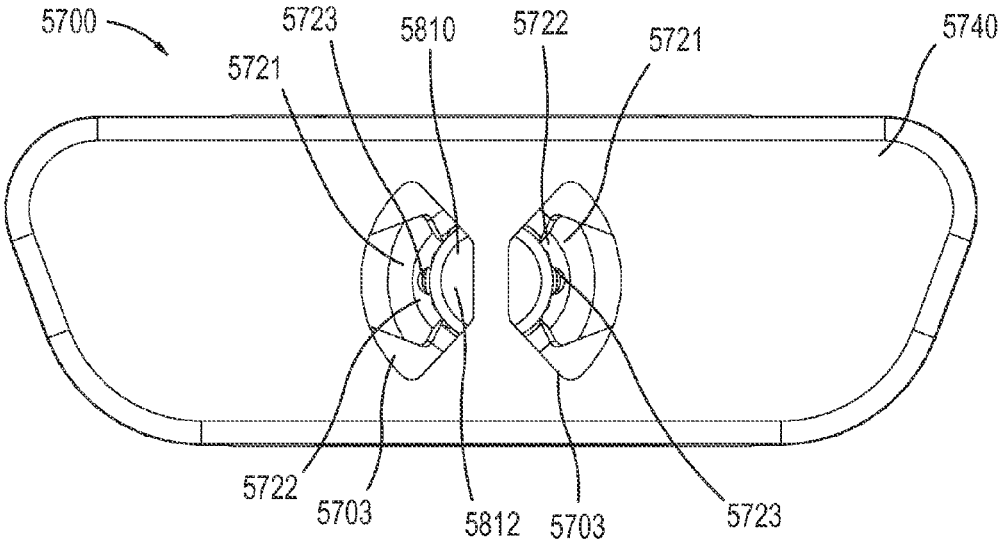
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FIG.85

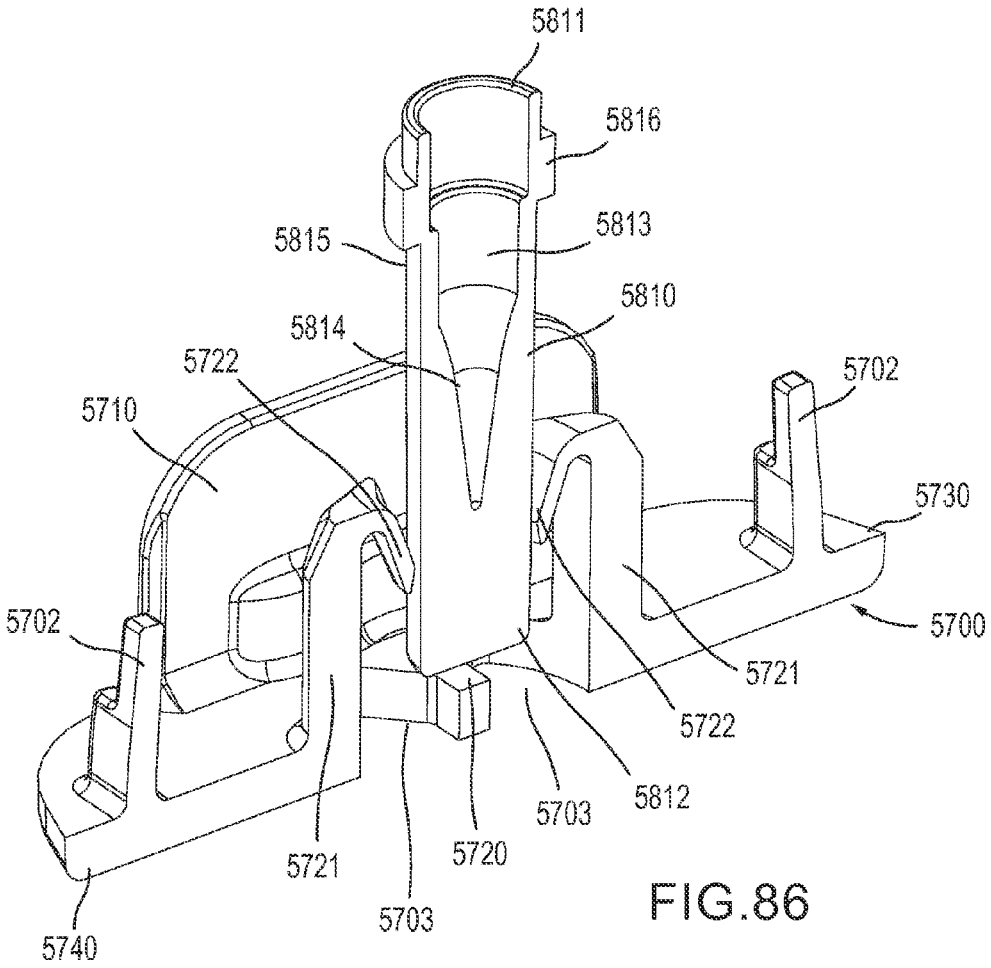
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FIG.86

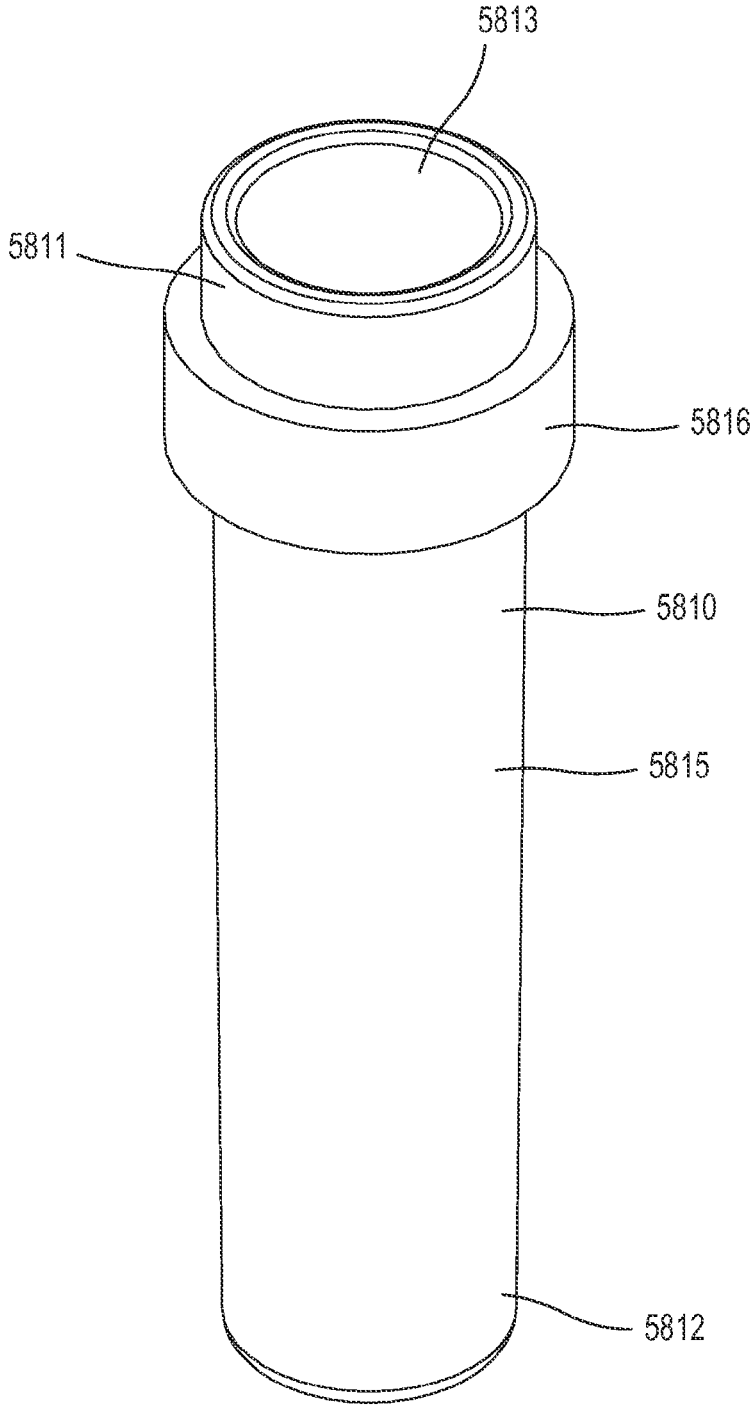

FIG.87

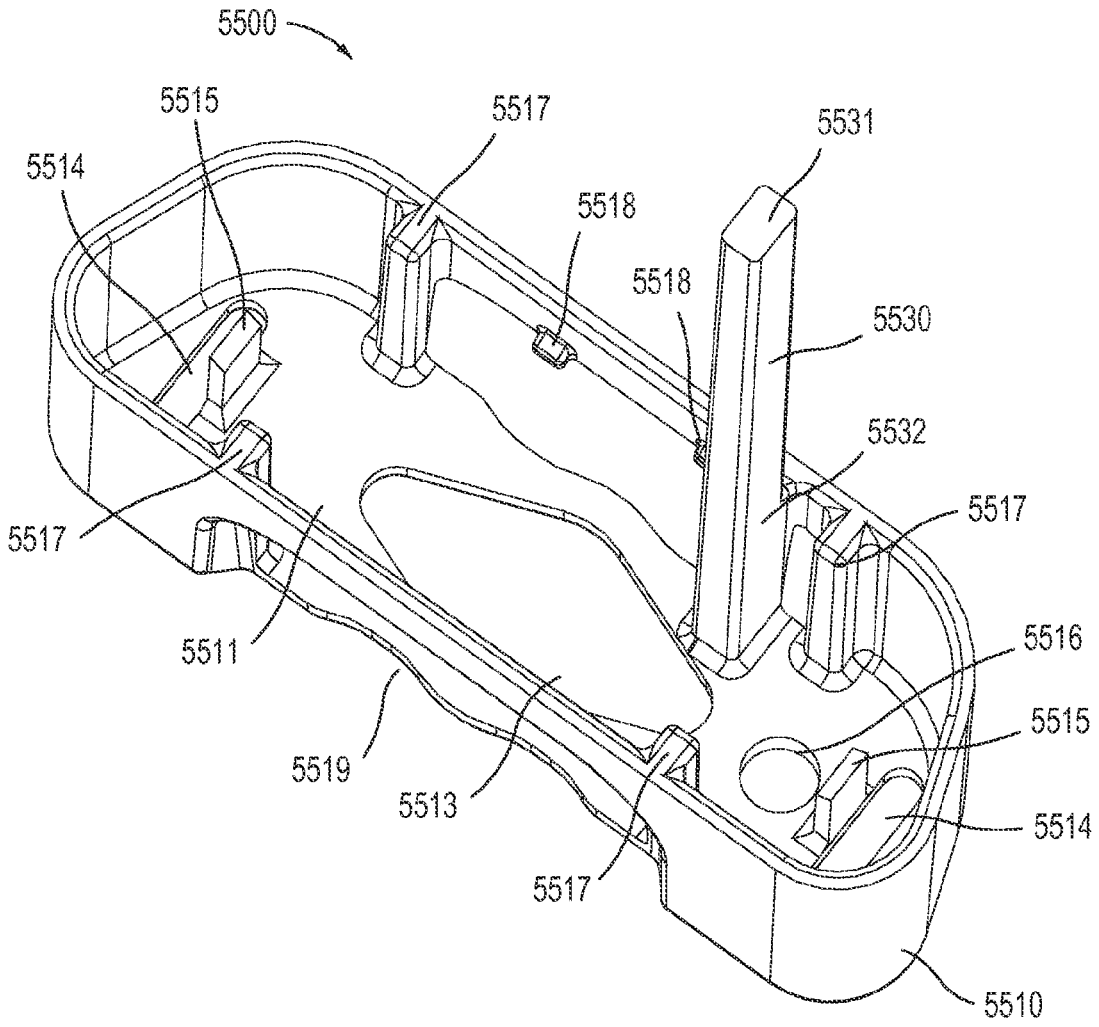
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FIG.88

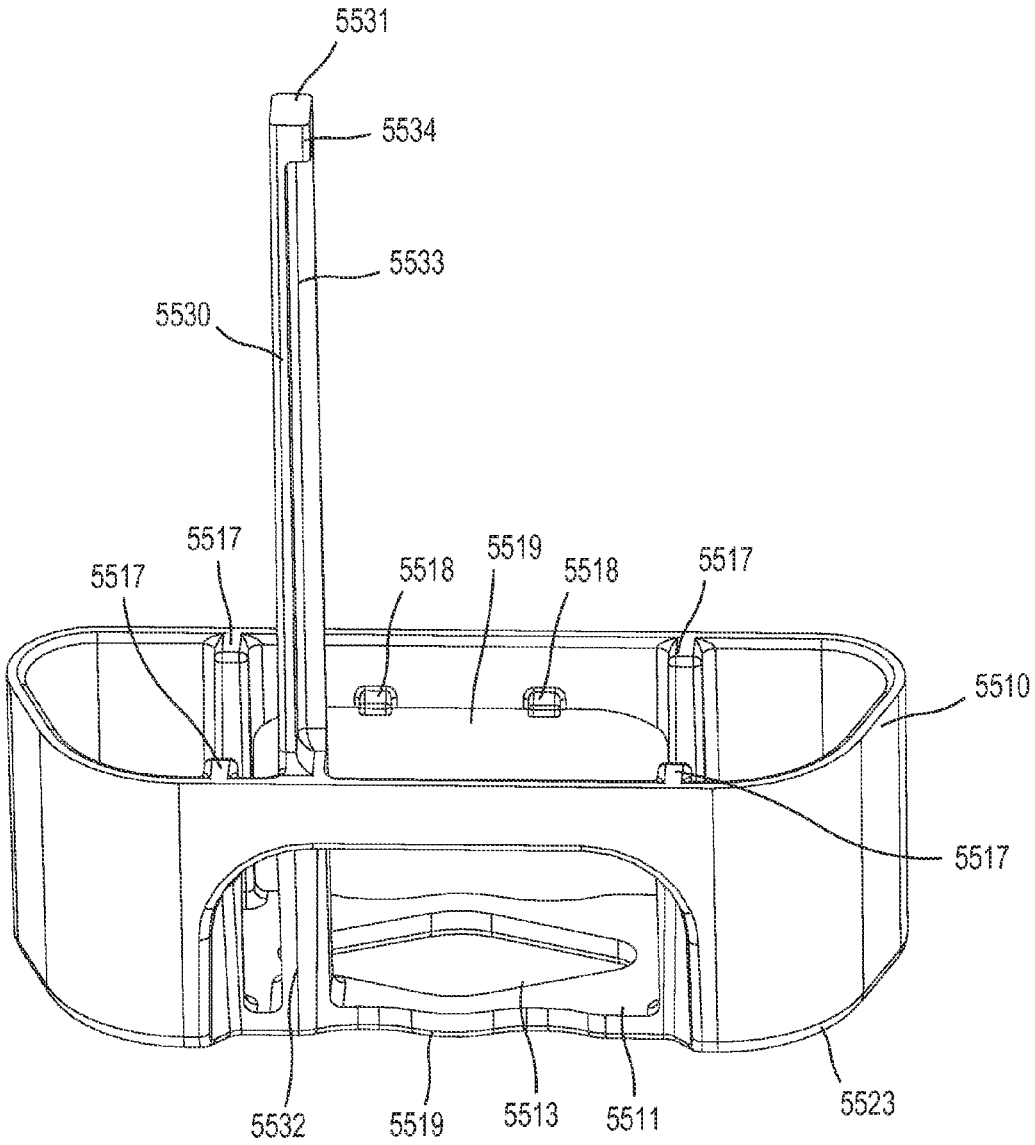
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FIG.89

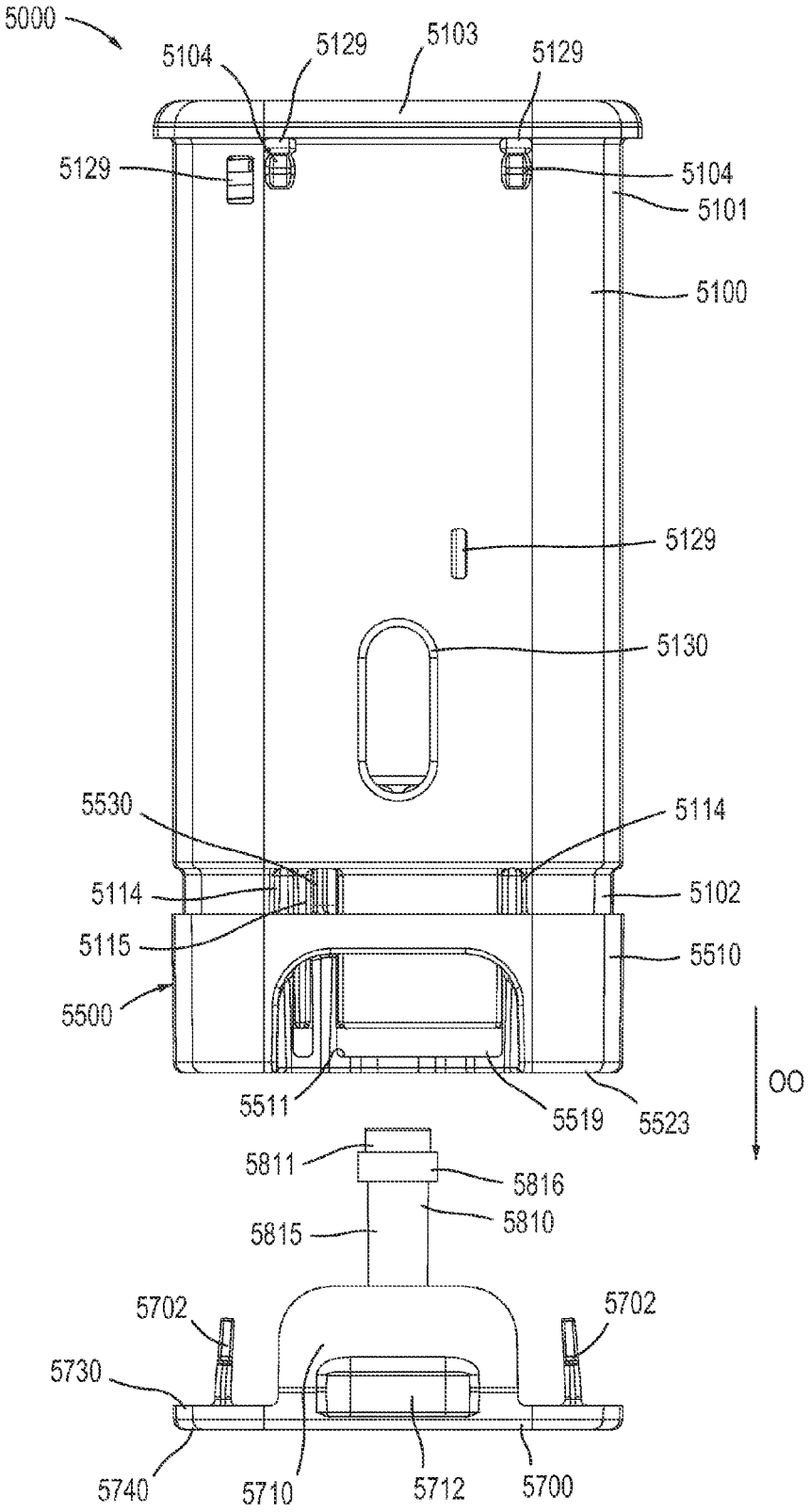
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FIG.90

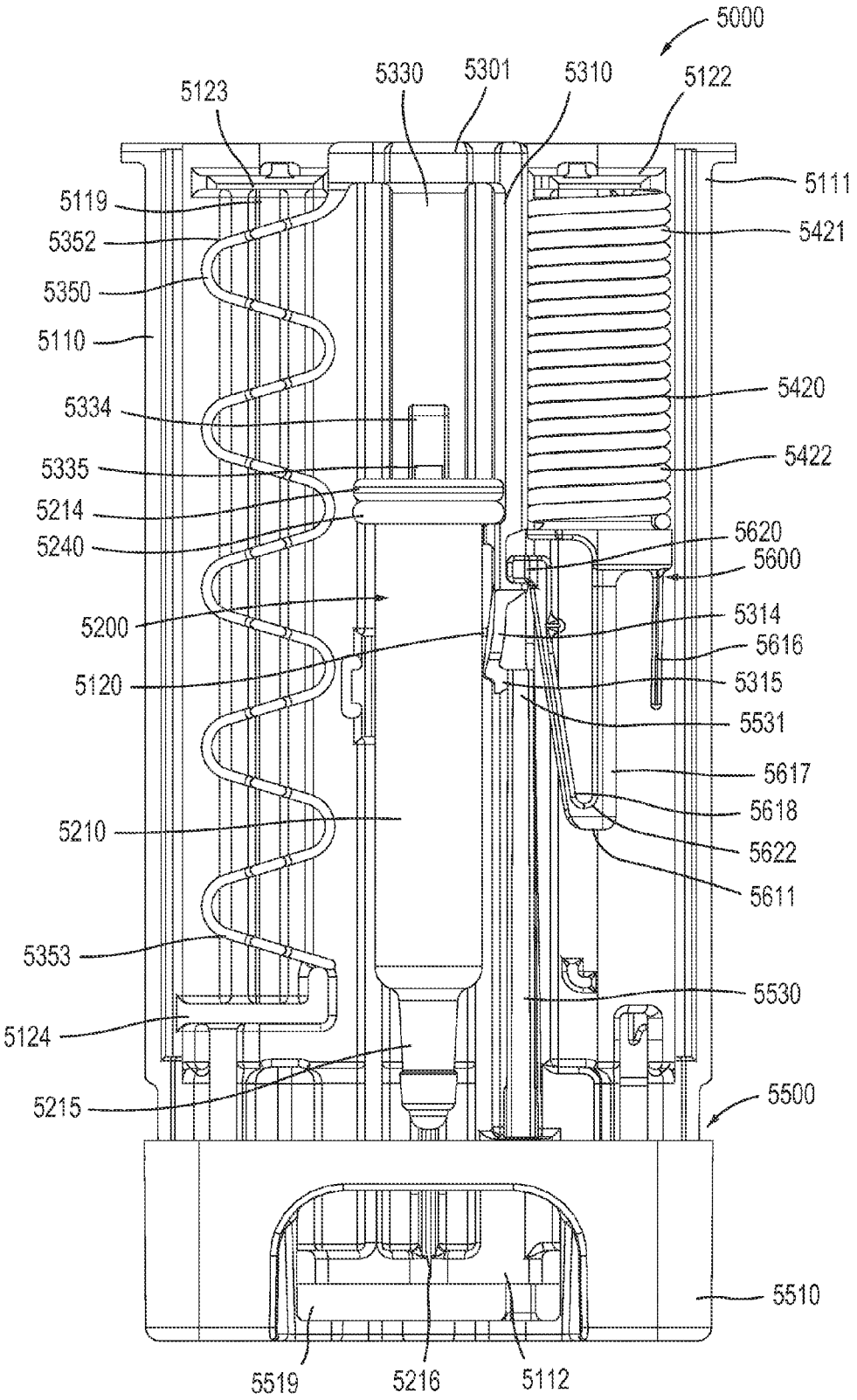
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FIG.91

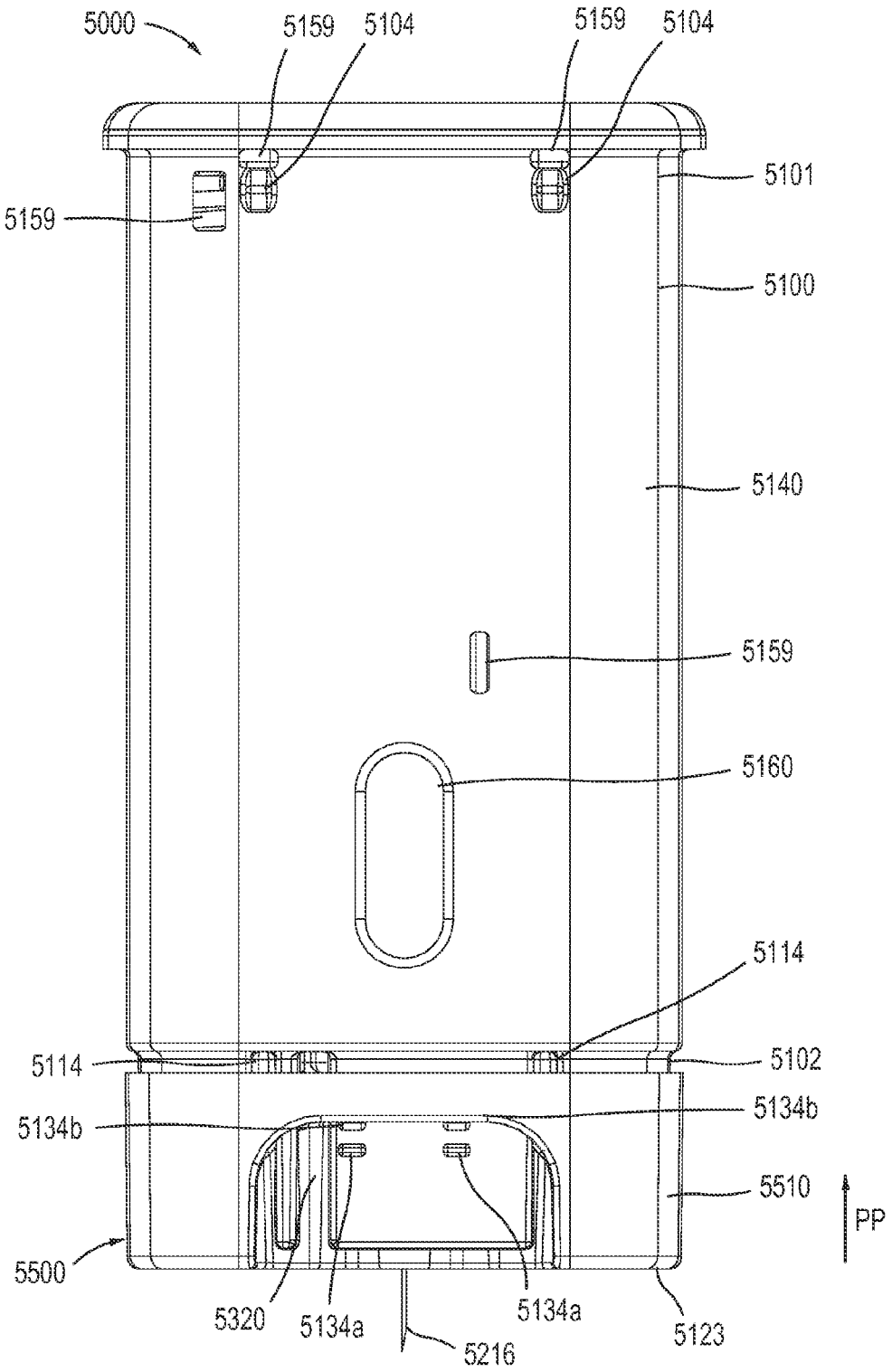
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FIG.92

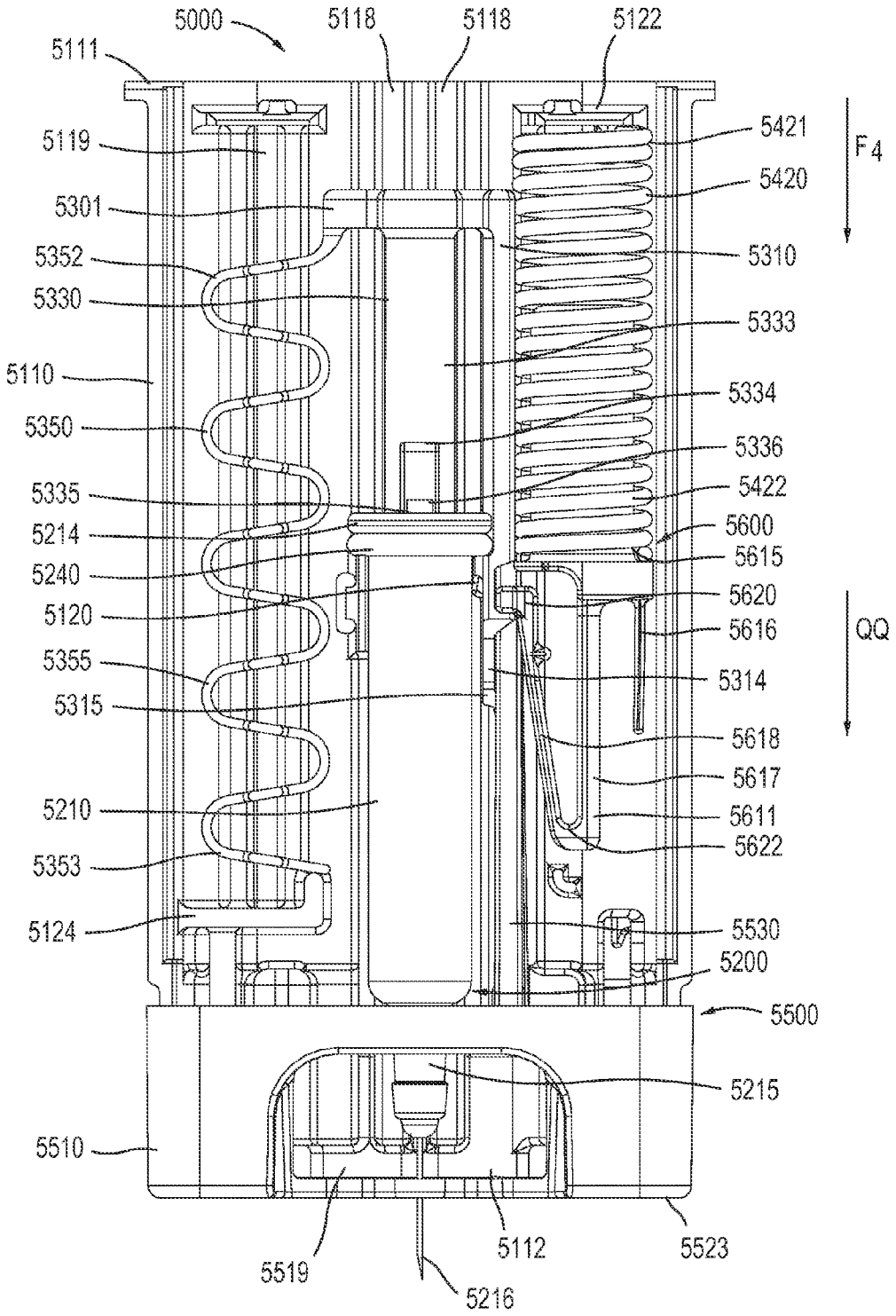
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FIG.93

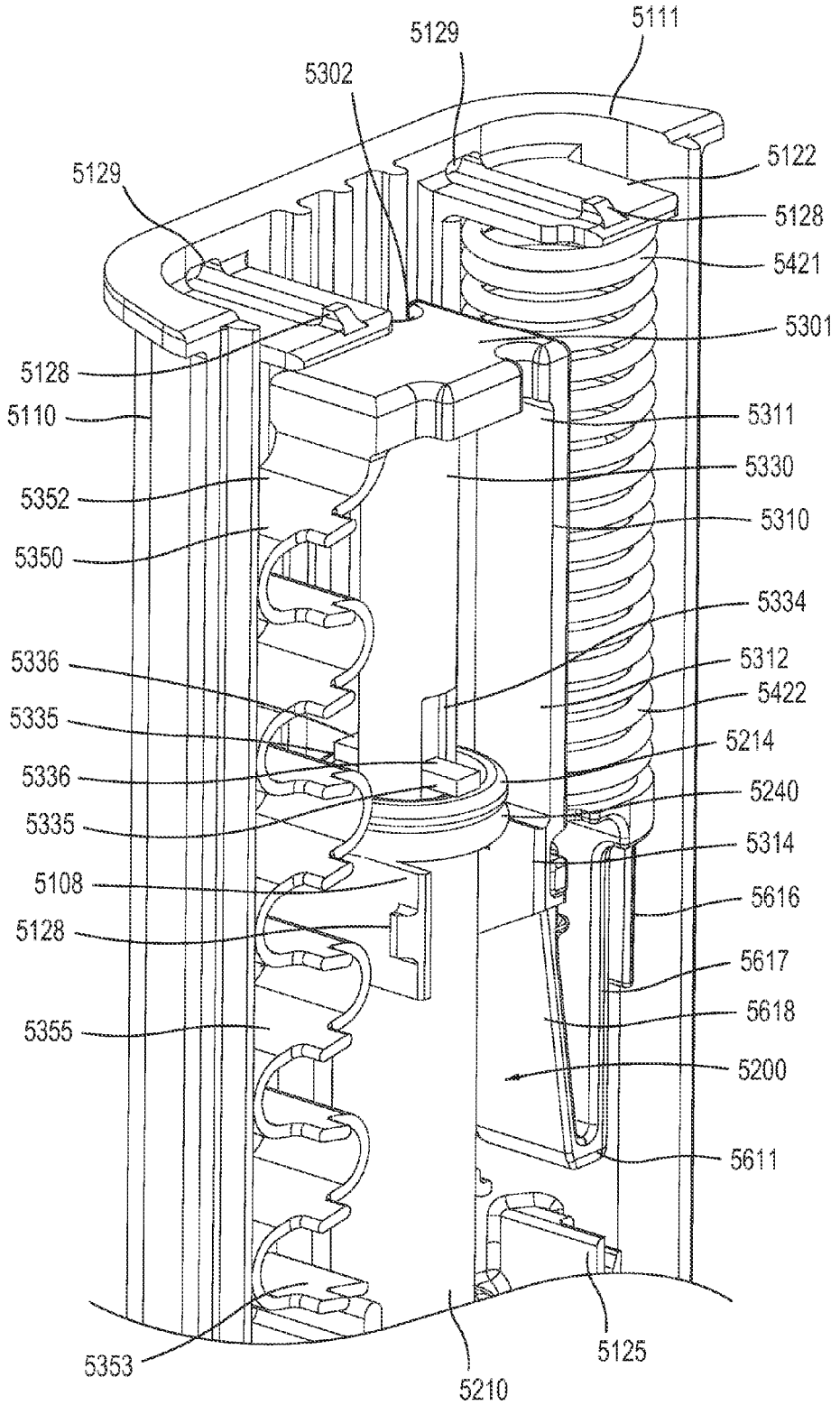
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FIG.94

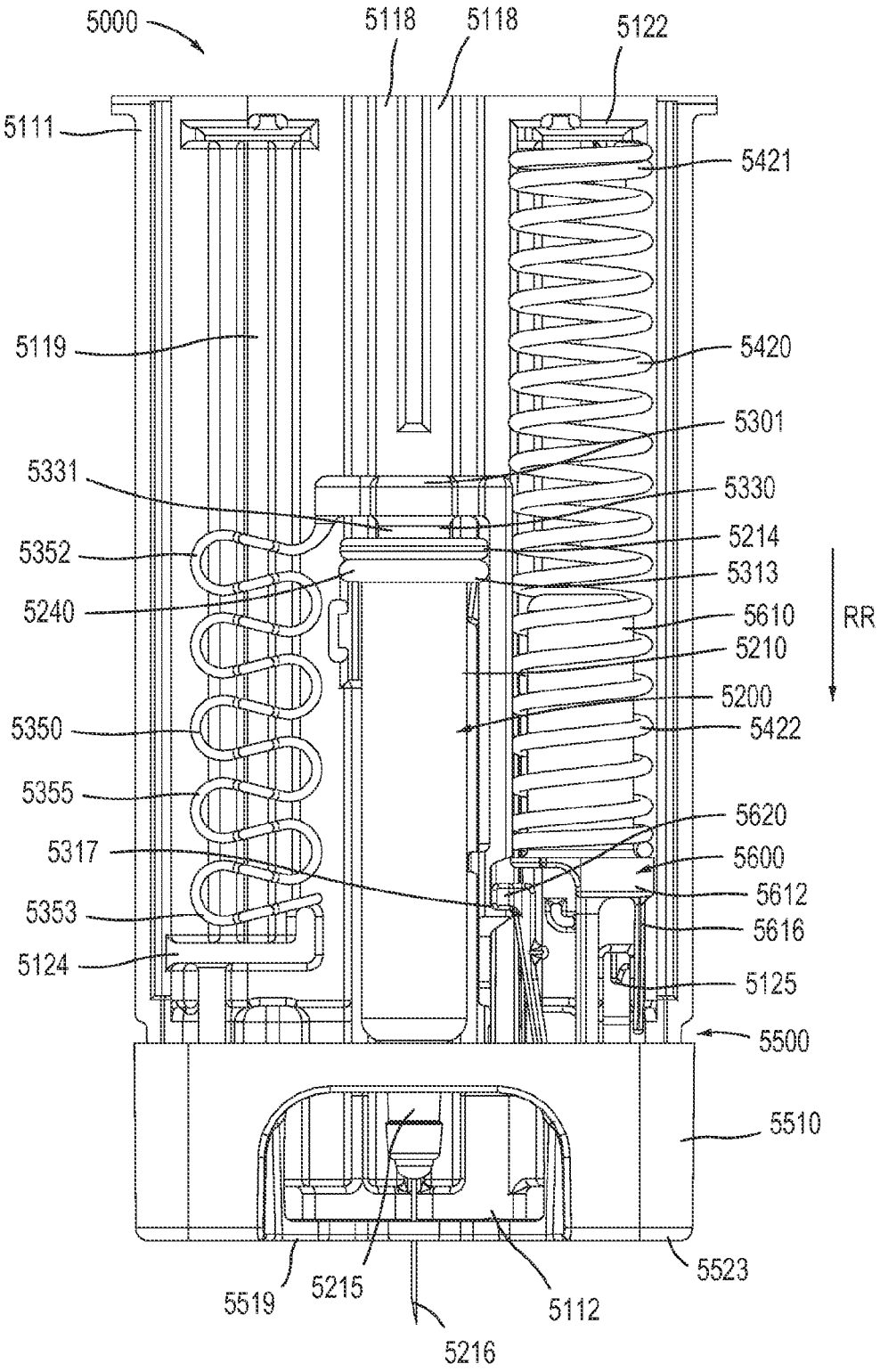
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FIG.95

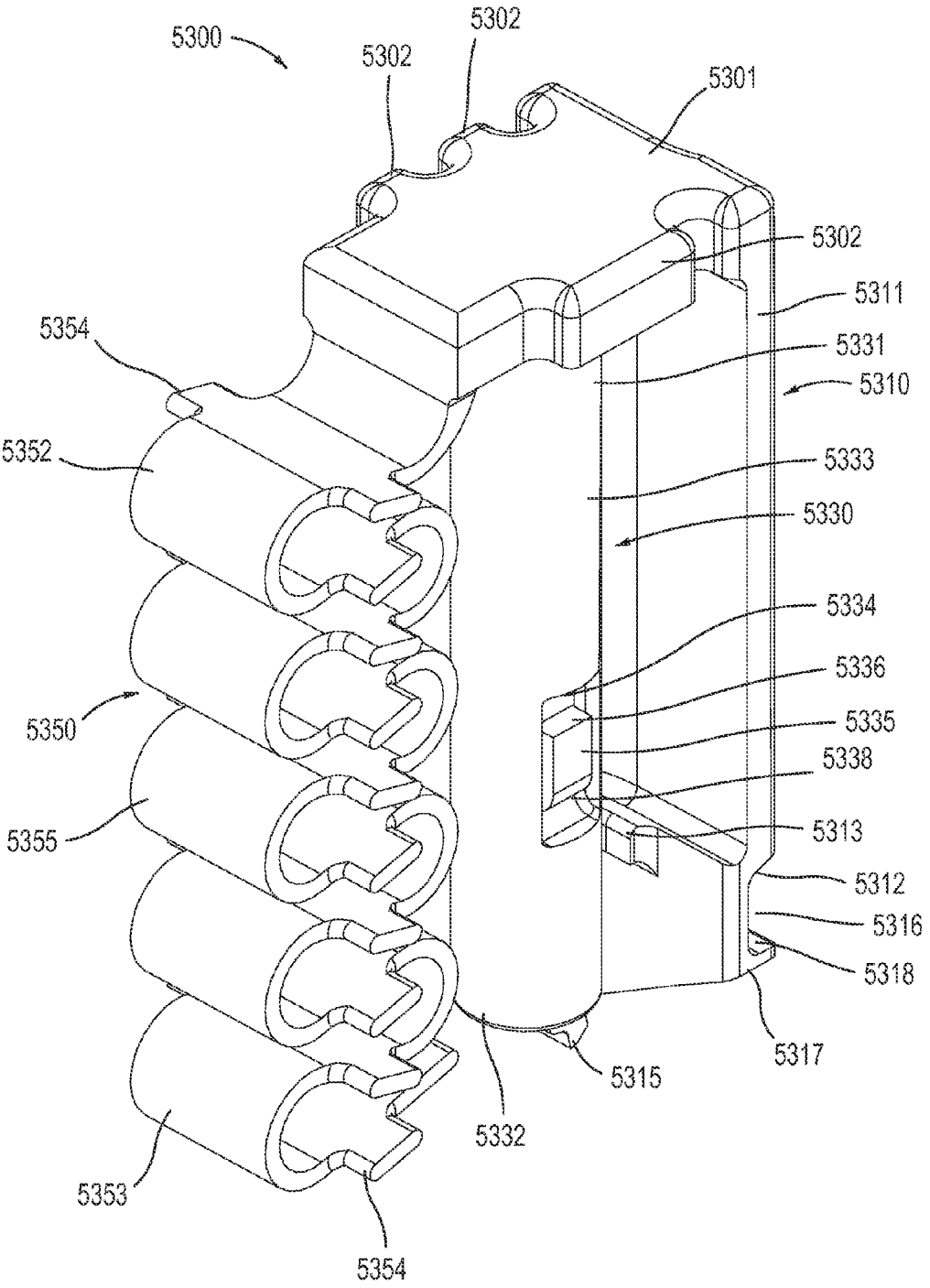
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FIG.96

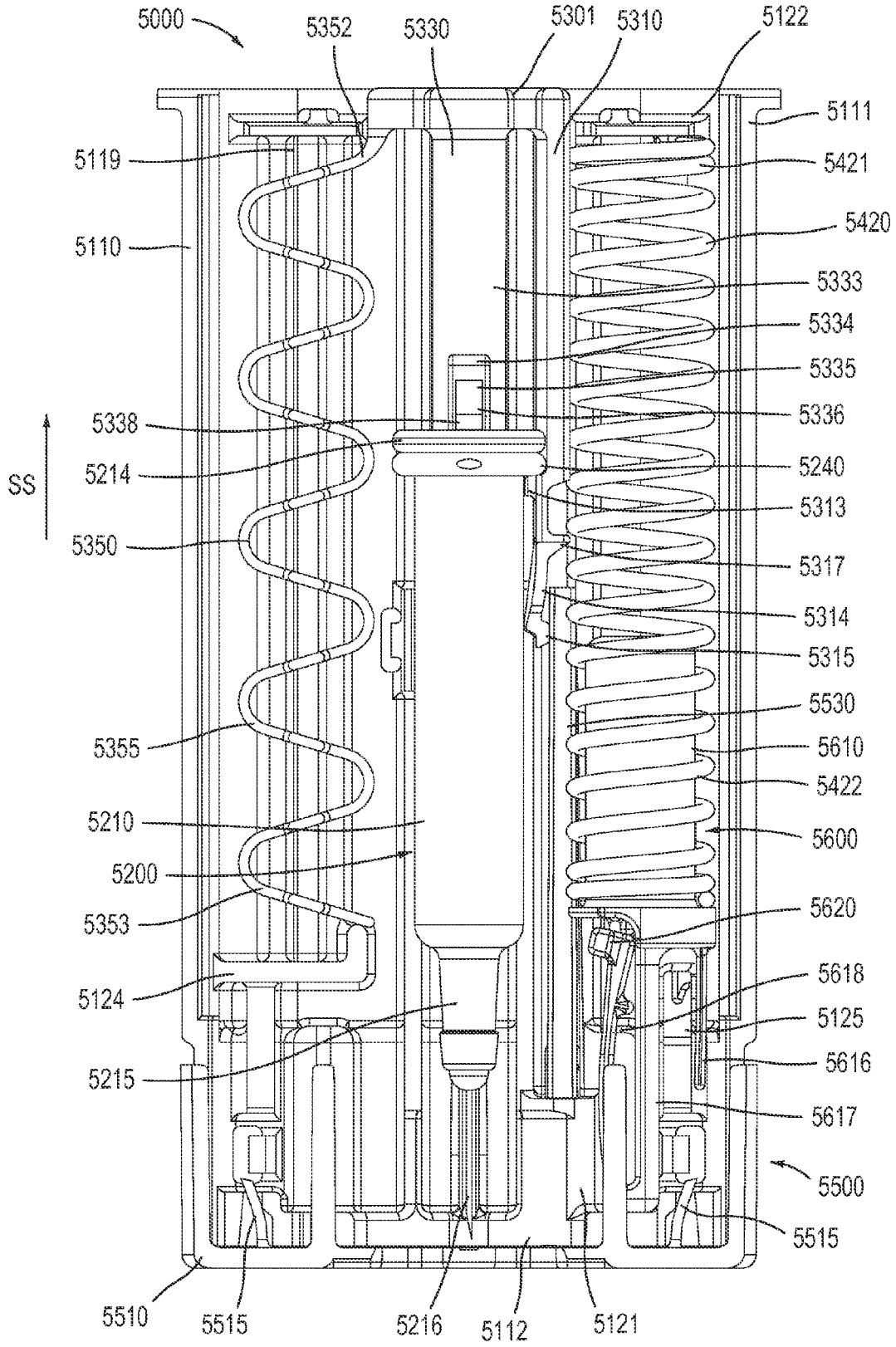
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FIG.97

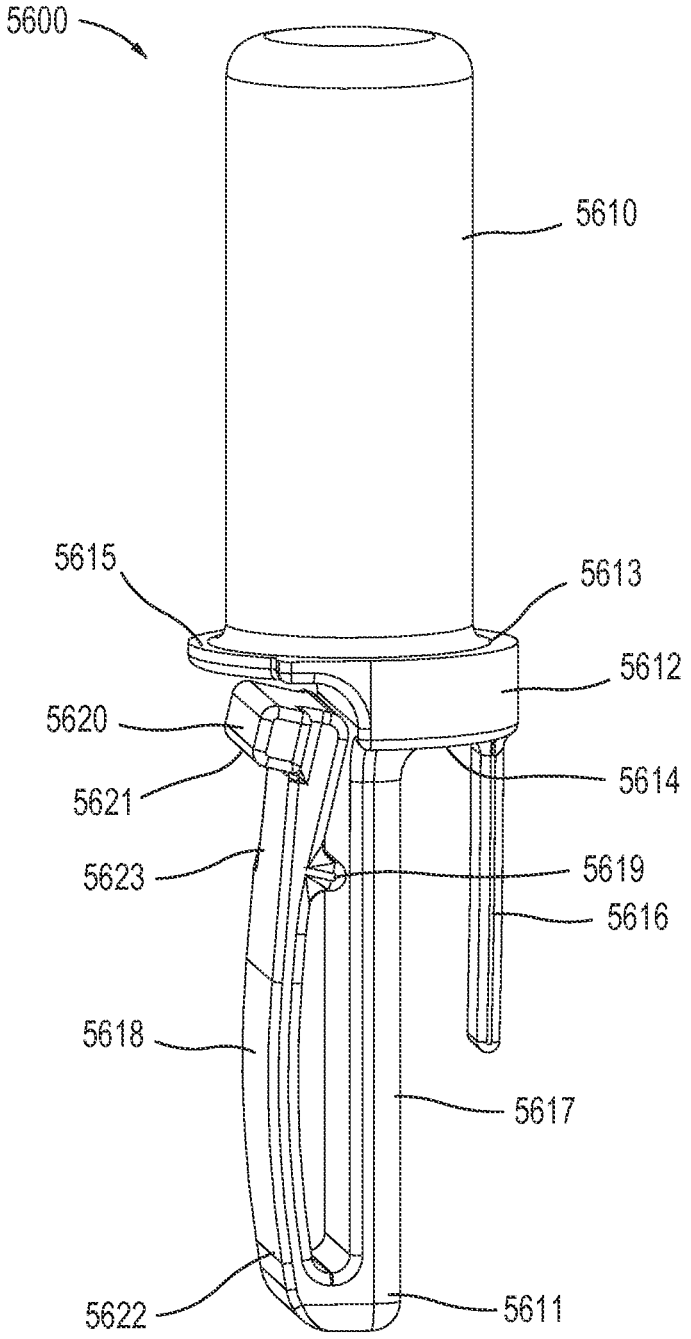
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FIG.98

MEDICAMENT DELIVERY DEVICES FOR ADMINISTRATION OF A MEDICAMENT WITHIN A PREFILLED SYRINGE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Application Ser. No. 61/436,301, entitled "Devices and Methods for Delivering Lyophilized Medicaments," filed Jan. 26, 2011, which is incorporated herein by reference in its entirety.

BACKGROUND

The embodiments described herein relate to medicament delivery devices. More particularly, the embodiments described herein relate to medicament delivery devices for delivery of medicaments contained within a prefilled syringe.

Known prefilled syringes are commonly used to contain and inject medicaments. Known prefilled syringes include a syringe body, often constructed from glass, within which a medicament is contained. The distal end portion of some known prefilled syringes includes a staked needle (i.e., a needle that is permanently coupled to the syringe body during manufacture), the end of which is disposed within a needle cover to maintain the sterility of the needle prior to use. Other known prefilled syringes include a Luer fitting or adapted such that the distal end portion of the syringe body can be coupled to a needle. The proximal end portion of the syringe body of known prefilled syringes includes a plunger (usually constructed from an elastomer) that defines a portion of the container closure, and that can be moved within the syringe body to inject the medicament. The proximal end portion also includes a flange to allow the user to grasp the syringe body and manually apply a force to a piston to move the plunger, thereby causing injection of the medicament.

Although prefilled syringes can be cost effective devices for storing and delivering medicaments, known methods for using prefilled syringes include manually inserting the needle into the body followed by manually applying the injection force. Moreover, upon completion of the injection, known methods include covering the needle to avoid needle sticks. Thus, known prefilled syringes are often used by healthcare professionals that are trained in such procedures. To facilitate the self-administration of medicaments contained in prefilled syringes, some known autoinjectors have been adapted to contain prefilled syringes. In this manner, the autoinjector provides a source of stored energy for inserting the needle and/or injecting the medicament.

Known autoinjectors, however, are often designed for a medicament container having a specific size and/or shape, and are therefore often not configured to receive known prefilled syringes. For example, using a prefilled syringe within a known autoinjector can often result in high forces being applied to the flange of the syringe body during the insertion operation, which can lead to breakage of the syringe flange or body. Moreover, because many known prefilled syringes include a staked needle that is in fluid communication with the medicament, applying a force to the plunger during storage and/or during an insertion operation is undesirable. For example, the application of a force against the plunger during storage, which can result, for example, when a spring-loaded member is placed in contact with the plunger, can cause in leakage of the medicament. As another example, the application of a force against the plunger during a needle insertion event can result in the injection of the medicament before the needle is inserted to the desired location. Similarly stated, some known autoinjectors are not configured to control the force applied to the plunger within the syringe body during storage and/or needle insertion.

Thus, a need exists for improved methods and devices for delivering medicaments contained within a prefilled syringe.

SUMMARY

Medicament delivery devices for administration of medicaments contained within a prefilled syringe are described herein. In some embodiments, an apparatus includes a housing, a medicament container and a movable member. The medicament container is configured to move within the housing between a first position and a second position in response to a force produced by an energy storage member. A proximal end portion of the medicament container includes a flange and has a plunger disposed therein. The movable member is configured to move within the housing. A first shoulder of the movable member is configured to exert the force on the flange to move the medicament container from the first position to the second position. A portion of the first shoulder is configured to deform when the medicament container is in the second position such that at least a portion of the force is exerted upon the plunger. A second shoulder of the movable member is configured to exert a retraction force on the flange to move the medicament container from the second position towards the first position.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. **1-4** are schematic illustrations of a medicament delivery device according to an embodiment, in a first, second, third and fourth configuration, respectively.

FIGS. **5-8** are schematic illustrations of a medicament delivery device according to an embodiment, in a first, second, third and fourth configuration, respectively.

FIGS. **9** and **10** are perspective views of a medical injector according to an embodiment, in a first configuration.

FIG. **11** is a front view of the medical injector illustrated in FIG. **9** with a cover removed.

FIG. **12** is a back view of the medical injector illustrated in FIG. **9** with the cover removed.

FIG. **13** is a front view of a portion of the medical injector illustrated in FIG. **9**.

FIG. **14** is a perspective view of a portion of the medical injector illustrated in FIG. **9**.

FIG. **15** is a bottom perspective view of a housing of the medical injector illustrated in FIG. **9**.

FIG. **16** is a top perspective view of a housing of the medical injector illustrated in FIG. **9**.

FIG. **17** is a perspective view of a proximal cap of the medical injector illustrated in FIG. **9**.

FIGS. **18** and **19** are front views of a medicament delivery mechanism of the medical injector illustrated in FIG. **9**.

FIG. **20** is a perspective view of a portion of the medical injector illustrated in FIG. **9**.

FIG. **21** is an enlarged cross-sectional view of a portion of the medical injector illustrated in FIG. **9**.

FIG. **22** is an exploded view of a medicament container of the medical injector illustrated in FIG. **9**.

FIGS. **23** and **24** are perspective views of a carrier included in the medical injector illustrated in FIG. **9** in a first configuration.

FIG. **25** is a perspective view of the carrier included in the medical injector illustrated in FIG. **9** in a second configuration.

FIG. **26** is a perspective view of a portion of the medical injector illustrated in FIG. **9**.

FIG. **27** is an enlarged front cross-sectional view of the portion of the medical injector illustrated in FIG. **26**.

FIG. **28** is an enlarged side cross-sectional view of the portion of the medical injector illustrated in FIG. **26**.

FIG. **29** is a back view of an electronic circuit system of the medical injector illustrated in FIG. **9**.

FIG. **30** is a front view of a portion of the electronic circuit system of the medical injector illustrated in FIG. **29**.

FIG. **31** is a side view of the electronic circuit system of the medical injector illustrated in FIG. **29**.

FIG. **32** is a front view of an electronic circuit system housing of the electronic circuit system illustrated in FIG. **29**.

FIG. **33** is a perspective view of the electronic circuit system housing of the electronic circuit system illustrated in FIG. **32**.

FIG. **34** is a perspective view of a battery clip of the electronic circuit system illustrated in FIG. **29**.

FIG. **35** is a perspective view of a portion of an electronic circuit system of the medical injector illustrated in FIG. **9**, in a first configuration.

FIG. **36** is a front view of the medical injector illustrated in FIG. **9** in a first configuration showing the electronic circuit system.

FIGS. **37-39** are front views of a portion of the electronic circuit system of the medical injector labeled as Region Z in FIG. **36** in a first configuration, a second configuration and a third configuration, respectively.

FIGS. **40** and **41** are perspective views of a cover of the medical injector illustrated in FIG. **9**.

FIG. **42** is a perspective view of a safety lock of the medical injector illustrated in FIG. **9**.

FIG. **43** is a front view of the safety lock of the medical injector illustrated in FIG. **42**.

FIG. **44** is a bottom view of the safety lock of the medical injector illustrated in FIG. **42**.

FIG. **45** is a cross-sectional view of the safety lock of the medical injector illustrated in FIG. **42**.

FIG. **46** is a perspective view of a needle sheath of the safety lock of the medical injector illustrated in FIG. **42**.

FIG. **47** is a perspective view of a base of the medical injector illustrated in FIG. **9**.

FIG. **48** is a front view of the base of the medical injector illustrated in FIG. **47**.

FIG. **49** is a back view of the medical injector illustrated in FIG. **9** in a second configuration.

FIG. **50** is a back view of the medical injector illustrated in FIG. **9** in a third configuration.

FIG. **51** is a back view of the medical injector illustrated in FIG. **9** in a fourth configuration (i.e., the needle insertion configuration).

FIG. **52** is a front view of a portion of the medical injector illustrated in FIG. **9** in the fourth configuration (i.e., the needle insertion configuration).

FIG. **53** is a front view of a portion of the medical injector illustrated in FIG. **9** in a fifth configuration (i.e., the injection configuration).

FIG. **54** is a front view of the medical injector illustrated in FIG. **9** in a sixth configuration (i.e., the retraction configuration).

FIG. **55** is an enlarged front cross-sectional view of a portion the medical injector illustrated in FIG. **9** in the sixth configuration (i.e., the retraction configuration).

FIG. **56** is a cross-sectional front view of a medical injector according to an embodiment, in a first configuration.

FIG. **57** is a cross-sectional front view of the medical injector illustrated in FIG. **56**, in a second configuration.

FIG. **58** is a perspective view of a portion of the medical injector illustrated in FIG. **56**, in a first configuration.

FIG. **59** is a perspective view of a portion of the medical injector illustrated in FIG. **56**, in a second configuration.

FIGS. **60** and **61** are perspective views of a medical injector according to an embodiment, in a first configuration.

FIG. **62** is a front view of the medical injector illustrated in FIG. **60** with a cover removed.

FIG. **63** is a back view of the medical injector illustrated in FIG. **60** with the cover removed.

FIG. **64** is a back view of a portion of the medical injector illustrated in FIG. **60**.

FIG. **65** is a bottom perspective view of a housing of the medical injector illustrated in FIG. **64**.

FIG. **66** is a front perspective views of a first portion of the housing of the medical injector illustrated in FIGS. **62** and **63**.

FIG. **67** is a rear perspective views of the first portion of the housing of the medical injector illustrated in FIG. **66**.

FIG. **68** is a front perspective views of a second portion of the housing of the medical injector illustrated in FIGS. **62** and **63**.

FIG. **69** is a rear perspective views of the second portion of the housing of the medical injector illustrated in FIG. **68**.

FIG. **70** is an enlarged view of a portion of the second portion of housing of the medical injector illustrated in FIG. **69**.

FIG. **71** is a front view of a medicament delivery mechanism of the medical injector illustrated in FIG. **60**.

FIG. **72** is an enlarged view of a portion of the medicament delivery mechanism on the medical injector illustrated in FIG. **71**.

FIG. **73** is an enlarged view of a portion of the medicament delivery mechanism on the medical injector illustrated in FIG. **71**.

FIG. **74** is an exploded view of a medicament container of the medical injector illustrated in FIG. **60**.

FIG. **75** is a front view of a first movable member of the medical injector illustrated in FIG. **60**, in a first configuration.

FIG. **76** is a front perspective view of the first movable member of the medical injector illustrated in FIG. **75**, in a first configuration.

FIG. **77** is a rear perspective view of the first movable member of the medical injector illustrated in FIG. **75**, in a first configuration.

FIG. **78** is a front view of a portion of the medical injector illustrated in FIG. **60**.

FIG. **79** is a front perspective view of a second movable member of the medical injector illustrated in FIG. **60**, in a first configuration.

FIG. **80** is a rear perspective view of the second movable member of the medical injector illustrated in FIG. **79** in a first configuration.

FIGS. **81** and **82** are perspective views of a cover of the medical injector illustrated in FIG. **60**.

FIG. **83** is a perspective view of a safety lock of the medical injector illustrated in FIG. **60**.

FIG. **84** is a front view of the safety lock of the medical injector illustrated in FIG. **83**.

FIG. **85** is a bottom view of the safety lock of the medical injector illustrated in FIG. **83**.

FIG. **86** is a cross-section view of the safety lock of the medical injector illustrated in FIG. **83**.

FIG. **87** is a perspective view of a needle sheath of the safety lock of the medical injector illustrated in FIG. **83**.

FIG. **88** is a perspective view of a base of the medical injector illustrated in FIG. **60**.

FIG. **89** is a front view of the base of the medical injector illustrated in FIG. **88**.

FIG. **90** is a front view of the medical injector illustrated in FIG. **60** in a third configuration.

FIG. **91** is a front view of a portion of the medical injector illustrated in FIG. **60** in the third configuration.

FIG. **92** is a front view of the medical injector illustrated in FIG. **60** in a fourth configuration (i.e., the needle insertion configuration).

FIG. **93** is a front view of a portion of the medical injector illustrated in FIG. **60** in the fourth configuration (i.e., the needle insertion configuration).

FIG. **94** is an enlarged perspective view of a portion of the medical injector illustrated in FIG. **60** in the fourth configuration (i.e., the needle insertion configuration).

FIG. **95** is a front view of the medical injector illustrated in FIG. **60** in a fifth configuration (i.e., the injection configuration).

FIG. **96** is a perspective view of a first movable member of the medical injector illustrated in FIG. **60** in a second configuration.

FIG. **97** is a front view of the medical injector illustrated in FIG. **60** in a sixth configuration (i.e., the retraction configuration).

FIG. **98** is a front perspective view of a second movable member of the medical injector illustrated in FIG. **60** in a second configuration.

DETAILED DESCRIPTION

Medicament delivery devices for administration of medicaments contained within a prefilled syringe are described herein. In some embodiments, an apparatus includes a housing, a medicament container and a movable member. The medicament container, which can be, for example, a prefilled syringe, is configured to move within the housing between a first position and a second position in response to a force produced by an energy storage member. The energy storage member can be, for example, a spring, a compressed gas container, an electrical energy storage member or the like. A proximal end portion of the medicament container includes a flange and has a plunger disposed therein. The movable member is configured to move within the housing. A first shoulder of the movable member is configured to exert the force on the flange to move the medicament container from the first position to the second position. A portion of the first shoulder is configured to deform when the medicament container is in the second position such that at least a portion of the force is exerted upon the plunger. A second shoulder of the movable member is configured to exert a retraction force on the flange to move the medicament container from the second position towards the first position.

In some embodiments, a medicament delivery device includes a housing, a medicament container, a movable member and an energy storage member. The medicament container is configured to move within the housing between a first position and a second position in response to a force produced by the energy storage member. A proximal end portion of the medicament container includes a flange and has a plunger disposed therein. The movable member is configured to exert the force on the medicament container to move the medicament container from the first position to the second position. An engagement portion of the movable member is configured to limit movement of a piston surface relative to the plunger when the medicament container moves from the first position to the second position such that the piston surface is spaced apart from the plunger. The engagement portion is configured to deform when the medicament container is in the second position such that the piston surface is in contact with the plunger.

In some embodiments, a medicament delivery device includes a housing, a medicament container, a first movable member and a second movable member. The medicament container is configured to move within the housing between a first position and a second position in response to a force produced by an energy storage member. A proximal end portion of the medicament container includes a flange and has a plunger disposed therein. The first movable member is configured to move within the housing, and is operably coupled to the energy storage member such that a first portion of the first movable member is configured to exert at least a portion of the force on the flange to move the medicament container from the first position to the second position. A second portion of the first movable member is configured to deform when the medicament container is in the second position such that at least a portion of the force is exerted upon the plunger. The second movable member is configured to move with the medicament container when the medicament container moves from the first position to the second position. The second movable member is configured to move relative to the medicament container to move the plunger within the medicament container after the second portion of the first movable member is deformed.

In some embodiments, a medical device includes a carrier configured to be disposed within a housing of the medical device. The carrier is configured to contain at least a proximal portion of a medicament container, such as, for example a prefilled syringe having a flange. A first shoulder of the carrier is in contact with a proximal surface of the flange and a second shoulder of the carrier is in contact with a distal surface of the flange. The carrier has a first engagement portion configured to engage a movable member such that when a first force is exerted by the movable member on the first engagement portion, the first shoulder transfers at least a portion of the first force to the proximal surface of the flange. The carrier has a second engagement portion configured to engage a retraction spring such that when a second force is exerted by the retraction spring on the second engagement portion, the second shoulder transfers at least a portion of the second force to the distal surface of the flange.

In some embodiments, the medical device further includes a damping member disposed between the first shoulder of the carrier and the proximal surface of the flange of the medicament container, or between the second shoulder of the carrier and the proximal surface of the flange of the medicament container. The damping member can be disposed such that a portion of the first force or a portion of the second force is received and/or absorbed by the damping member to reduce the possibility of damage to the medicament container and/or flange.

In some embodiments, a medical device includes a housing, a movable member and a medicament container. The movable member is disposed within the housing and has a first engagement portion, a second engagement portion and a retraction portion. The first engagement portion is configured to be coupled to an energy storage member. The second engagement portion is configured to be coupled to the medicament container such that a shoulder of the second engagement portion exerts a first force produced by the energy storage member on the medicament container to move the medicament container within the housing in a first direction. The retraction portion is configured to produce a second force

to move the medicament container within the housing in a second direction. In some embodiments, the retraction portion includes a spring that is monolithically constructed with at least the second engagement portion.

As used in this specification and the appended claims, the words "proximal" and "distal" refer to direction closer to and away from, respectively, an operator of the medical device. Thus, for example, the end of the medicament delivery device contacting the patient's body would be the distal end of the medicament delivery device, while the end opposite the distal end would be the proximal end of the medicament delivery device.

FIGS. **1-4** are schematic illustrations of a medicament delivery device **1000** according to an embodiment in a first, second, third and fourth configuration, respectively. The medicament delivery device **1000** includes a housing **1100**, a medicament container **1200**, a movable member **1300**, an energy storage member **1400** and a retraction member **1351**. The housing **1100** can be any suitable size, shape, or configuration and can be made of any suitable material. For example, in some embodiments, the housing **1100** is an assembly of multiple parts formed from a plastic material and defines a substantially rectangular shape when assembled.

The medicament container **1200** is disposed within the housing **1100**, and contains (i.e., is filled or partially filled with) a medicament. The medicament container **1200** includes a proximal end portion **1212** that has a flange **1214** and a distal end portion **1213** that is coupled to a needle (not shown in FIGS. **1-4**). The medicament container **1200** includes an elastomeric member **1217** (also referred to herein as a "plunger"). The elastomeric member **1217** is formulated to be compatible with the medicament housed within the medicament container **1200**. Similarly stated, the elastomeric member **1217** is formulated to minimize any reduction in the efficacy of the medicament that may result from contact (either direct or indirect) between the elastomeric member **1217** and the medicament. For example, in some embodiments, the elastomeric member **1217** can be formulated to minimize any leaching or out-gassing of compositions that may have an undesired effect on the medicament. The elastomeric member **1217** is disposed within the medicament container **1200** to seal the proximal end portion **1212** of the medicament container **1200**. In some embodiments, the elastomeric member **1217** can be formulated to maintain its chemical stability, flexibility and/or sealing properties when in contact (either direct or indirect) with a medicament over a long period of time (e.g., for up to six months, one year, two years, five years or longer). The medicament container **1200** can be any container suitable for storing the medicament. In some embodiments, the medicament container **1200** can be, for example, a prefilled syringe having a staked needle at the distal end thereof. In those embodiments in which the medicament container **1200** is a prefilled syringe, the elastomeric member **1217** can be disposed within the medicament container **1200** during the fill process (e.g., before being placed in the housing **1100**).

The energy storage member **1400** can be any suitable device or mechanism that, when actuated, produces a force F_1 to deliver the medicament contained within the medicament container **1200**. Similarly stated, the energy storage member **1400** can be any suitable device or mechanism that produces the force F_1 such that the medicament is conveyed from the medicament container **1200** into a body of a patient. More specifically, the energy storage member **1400** produces the force F_1 that moves the medicament container **1200** from a first position to a second position in a first direction indicated by the arrow AA in FIG. **2** and/or that moves the plunger **1217** from a first plunger position to a second plunger position as shown by the arrow BB in FIG. **3**. The medicament can be conveyed into a body via any suitable mechanism, such as, for example, by injection. By employing the energy storage member **1400** to produce the force F_1 rather than relying on a user to manually produce the delivery force, the medicament can be delivered into the body at the desired pressure and/or flow rate, and with the desired delivery characteristics. Moreover, this arrangement reduces the likelihood of partial delivery (e.g., that may result if the user is interrupted or otherwise rendered unable to manually produce the force to complete the delivery).

In some embodiments, the energy storage member **1400** can be a mechanical energy storage member, such as a spring, a device containing compressed gas, a device containing a vapor pressure-based propellant or the like. In other embodiments, the energy storage member **1400** can be an electrical energy storage member, such as a battery, a capacitor, a magnetic energy storage member or the like. In yet other embodiments, the energy storage member **1400** can be a chemical energy storage member, such as a container containing two substances that, when mixed, react to produce energy.

The energy storage member **1400** can be disposed within the housing in any position and/or orientation relative to the medicament container **1200**. In some embodiments, for example, the energy storage member **1400** can be positioned within the housing **1100** spaced apart from the medicament container **1200**. Moreover, in some embodiments, the energy storage member **1400** can be positioned such that a longitudinal axis of the energy storage member **1400** is offset from the medicament container **1200**. In other embodiments, the energy storage member **1400** can substantially surround the medicament container **1200**.

As shown in FIG. **1**, the energy storage member **1400** is operably coupled to the movable member **1300**, the medicament container **1200** and/or the medicament therein such that the force F_1 delivers the medicament. In some embodiments, for example, the force F_1 can be transmitted to the medicament container **1200** and/or the medicament therein via the movable member **1300**. The movable member **1300** can be any suitable member, device, assembly or mechanism configured to move within the housing **1100**. As shown in FIGS. **1-4**, the movable member **1300** includes a piston portion **1330** configured to transmit the force F_1 to the plunger **1217** disposed within the medicament container **1200**.

The movable member **1300** includes a first shoulder **1335** and a second shoulder **1337**. The first shoulder **1335** of the movable member **1300** is configured to exert the force F_1, produced by the energy storage member **1400**, on the flange **1214** of the medicament container **1200**. In this manner, when the medicament delivery device **1000** is actuated to produce the force F_1, movable member **1300** moves the medicament container **1200** from the first position (see FIG. **1**, which corresponds to the first configuration of the medicament delivery device **1000**) to the second position (see FIG. **2**, which corresponds to the second configuration of the medicament delivery device **1000**). In some embodiments, the movement of the medicament container **1200** within the housing **1100** results in a needle insertion operation. Although the first shoulder **1335** is shown as directly contacting the flange **1214** when the medicament delivery device **1000** is in the second configuration (FIG. **2**), in other embodiments, there can be intervening structure (e.g., an o-ring, a damping member, or the like) disposed between the first shoulder **1335** and the flange **1214**.

In some embodiments, the first shoulder **1335** of the movable member **1300** can be configured to maintain a distance

between the piston portion **1330** of the movable member **1300** and the plunger **1217** when the medicament delivery device **1000** is in the first configuration (FIG. **1**). Similarly stated, in some embodiments, the movable member **1300** and the medicament container **1200** are collectively configured such that the piston portion **1330** is spaced apart from the plunger **1217** when the medicament delivery device **1000** is in its storage configuration and/or when the medicament container **1200** is moving between its first position and its second position. In this manner, any preload or residual force produced by the energy storage member **1400** on the movable member **1300** is not transferred to the plunger **1217**. Said another way, the plunger **1217** is isolated from the energy storage member **1400** during the storage configuration. Accordingly, this arrangement reduces and/or eliminates medicament leakage from the medicament container **1200**.

As shown in FIG. **3**, the first shoulder **1335** includes a deformable portion **1338** configured to deform when the medicament container **1200** is in the second position such that at least a portion of the force F_1 is exerted upon the plunger **1217**. In some embodiments, the deformable portion **1338** can be separated from the piston portion **1330** of the movable member **1300**. In other embodiments, the deformable portion **1338** is configured to bend, deform, rotate and/or otherwise move relative to the piston portion **1300** such that the piston portion **1330** is placed into contact (directly or indirectly via intervening structure) with the plunger **1217**. Similarly stated, in some embodiments, the deformable portion **1338** is configured to bend, deform, rotate and/or otherwise move relative to the piston portion **1300** such that the first shoulder **1335** no longer maintains the distance between the piston portion **1300** and the plunger **1217**. In this manner, the piston portion **1330** transmits at least a portion of the force F_1 to the plunger **1217**, thereby placing the medicament container **1200** into the third configuration (FIG. **3**). More specifically, when the deformable portion **1338** deforms, the piston portion **1330** moves within the medicament container **1200** in the direction of the arrow BB (FIG. **3**) and moves the plunger **1217** from the proximal end portion **1212** of the medicament container **1200** towards the distal end portion **1213** of the medicament container **1200**. This arrangement allows for the delivery of the medicament contained within the medicament container **1200** into a body of a patient.

When the medicament is delivered, the retraction member **1351** exerts a retraction force F_2 on at least the second shoulder **1337** of the movable member **1300** in a second direction, opposite the first direction. When the retraction force F_2 is exerted, the second shoulder **1337** engages a distal surface of the flange **1214** of the medicament container **1200**, thereby exerting at least a portion of the refraction force F_2 on the flange **1214**. Although the second shoulder **1337** is shown as directly contacting the flange **1214** when the medicament delivery device **1000** is in the fourth configuration (FIG. **4**), in other embodiments, there can be intervening structure (e.g., an o-ring, a damping member, or the like) disposed between the second shoulder **1337** and the flange **1214**. The exertion of the retraction force F_2 on the flange **1214** moves the medicament container **1200** from the second position (e.g., the second and third configuration, as shown in FIGS. **2** and **3**) in the direction of the arrow CC toward the first position. In this manner, the retraction member **1351** produces the retraction force F_2 and moves the distal end portion **1213** of the medicament container **1200** (which can include, for example, a needle) away from the body of the patient and into the housing **1100** of the medicament delivery device **1000**.

The retraction member **1351** can be any suitable device or mechanism that, when actuated, produces a force F_2 to move the medicament container **1200** in the second direction as indicated by the arrow CC in FIG. **4**. In some embodiments, the retraction member **1351** can be a mechanical energy storage member, such as a spring, a device containing compressed gas, a device containing a vapor pressure-based propellant or the like. In other embodiments, the retraction member **1351** can be an electrical energy storage member, such as a battery, a capacitor, a magnetic energy storage member or the like. In yet other embodiments, the refraction member **1351** can be a chemical energy storage member, such as a container containing two substances that, when mixed, react to produce energy. Although the retraction member **1351** is shown as being separate and distinct from the energy storage member **1400**, in some embodiments, the energy storage member **1400** can be configured to produce the retraction force F_2.

The retraction member **1351** can be in any position and/or orientation relative to the medicament container **1200**. In some embodiments, for example, the retraction member **1351** can be positioned within the housing **1100** spaced apart from the medicament container **1200**. Moreover, in some embodiments, the retraction member **1351** can be positioned such that a longitudinal axis of the retraction member **1351** is offset from the medicament container **1200**. In other embodiments, the retraction member **1351** can substantially surround the medicament container **1200**. In some embodiments, the retraction member **1351** is coupled to the second shoulder **1337** of the movable member **1300**. In other embodiments, the retraction member **1351** is monolithically formed with the movable member **1300**.

FIGS. **5-8** are schematic illustrations of a medicament delivery device **2000** according to an embodiment in a first, second, third and fourth configuration, respectively. The medicament delivery device **2000** includes a housing **2100**, a medicament container **2200**, a first movable member **2300**, a second movable member **2345** and an energy storage member **2400**. The housing **2100** can be any suitable size, shape, or configuration and can be made of any suitable material. For example, in some embodiments, the housing **2100** is an assembly of multiple parts formed from a plastic material and defines a substantially rectangular shape when assembled.

The medicament container **2200** is disposed within the housing **2100**, and contains (i.e., is filled or partially filled with) a medicament. The medicament container **2200** includes a proximal end portion **2212** that has a flange **2214** and a distal end portion **2213** that is coupled to a delivery member, such as a needle, nozzle or the like (not shown in FIGS. **5-8**). The medicament container **2200** includes an elastomeric member **2217**. The elastomeric member **2217** is formulated to be compatible with the medicament housed within the medicament container **2200**. Similarly stated, the elastomeric member **2217** is formulated to minimize any reduction in the efficacy of the medicament that may result from contact (either direct or indirect) between the elastomeric member **2217** and the medicament. For example, in some embodiments, the elastomeric member **2217** can be formulated to minimize any leaching or out-gassing of compositions that may have an undesired effect on the medicament. The elastomeric member **2217** is disposed within the medicament container **2200** to seal the proximal end portion **2212** of the medicament container **2200**. In some embodiments, the elastomeric member **2217** can be formulated to maintain its chemical stability, flexibility and/or sealing properties when in contact (either direct or indirect) with a medicament over a long period of time (e.g., for up to six months, one year, two years, five years or longer). The medicament container **2200** can be any container suitable for storing the medicament. In

some embodiments, the medicament container **2200** can be, for example, a prefilled syringe having a staked needle at the distal end thereof. In those embodiments in which the medicament container **1200** is a prefilled syringe, the elastomeric member **2217** is disposed within the medicament container **2200** during the fill process (e.g., before the prefilled syringe is placed in the housing **2100**).

The energy storage member **2400** can be any suitable device or mechanism that, when actuated, produces a force F_3 to deliver the medicament contained within the medicament container **2200**. Similarly stated, the energy storage member **2400** can be any suitable device or mechanism that produces the force F_3 such that the medicament is conveyed from the medicament container **2200** into a body of a patient. More specifically, the energy storage member **2400** produces the force F_3 that moves the medicament container **2200** from a first position to a second position in a first direction indicated by the arrow DD in FIG. **6** and/or that moves the plunger **2217** from a first plunger position to a second plunger position, as shown by the arrow EE in FIG. **7**. The medicament can be conveyed into a body via any suitable mechanism, such as, for example, by injection via a needle, nozzle or the like.

In some embodiments, the energy storage member **2400** can be a mechanical energy storage member, such as a spring, a device containing compressed gas, a device containing a vapor pressure-based propellant or the like. In other embodiments, the energy storage member **2400** can be an electrical energy storage member, such as a battery, a capacitor, a magnetic energy storage member or the like. In yet other embodiments, the energy storage member **2400** can be a chemical energy storage member, such as a container containing two substances that, when mixed, react to produce energy.

The energy storage member **2400** can be in any position and/or orientation relative to the medicament container **2200**. In some embodiments, for example, the energy storage member **2400** can be positioned within the housing **2100** spaced apart from the medicament container **2200**. Moreover, in some embodiments, the energy storage member **2400** can be positioned such that a longitudinal axis of the energy storage member **2400** is offset from the medicament container **2200**. In other embodiments, the energy storage member **2400** can substantially surround the medicament container **2200**.

As shown in FIG. **5**, the energy storage member **2400** is operably coupled to the first movable member **2300**, the second movable member **2345**, the medicament container **2200** and/or the medicament therein such that the force F_3 delivers the medicament. In some embodiments, for example, the force F_3 can be transmitted to the medicament and/or the medicament container **2200** via the first movable member **2300** and/or the second movable member **2345**. As described in more detail herein, the first movable member **2300** and the second movable member **2345** are collectively configured to transmit the force F_3 to the plunger **2217** disposed within the medicament container **2200**.

The first movable member **2300** includes a first portion **2335** and a second portion **2338**. The first portion **2335** of the movable member **2300** is configured to transmit and/or exert at least a portion of the force F_3 produced by the energy storage member **2400** on the flange **2214** of the medicament container **2200** to move the medicament container **2200** from the first position (see FIG. **5**, which corresponds to the first configuration of the medicament delivery device **2000**) to the second position (see FIG. **6**, which corresponds to the second configuration of the medicament delivery device **2000**). Although the medicament container **2200** is shown as being within the housing **2100** when the medicament container **2200** is in the second position, in some embodiments, the movement of the medicament container **2200** can result in a needle insertion operation in which a needle (not shown in FIGS. **5-8**) is extended outside of the housing **2100**. The first portion **2335** of the movable member **2300** can be, for example, a first shoulder, protrusion, sleeve or the like. Although the first portion **2335** is shown as directly contacting the flange **2214** when the medicament delivery device **2000** is in the second configuration (FIG. **6**), in other embodiments, there can be intervening structure (e.g., an o-ring, a damping member, or the like) disposed between the first portion **2335** and the flange **2214**.

The second portion **2338** of the first movable member **2300** maintains the second movable member **2345** in a first position (FIGS. **5** and **6**), relative to the medicament container **2200** and/or the first movable member **2300** when the medicament delivery device **2000** is in the first (i.e., storage) configuration (FIG. **5**). In this manner, as shown in FIG. **6**, at least a portion of the force F_3 can be transferred from the energy storage member **2400** to the first movable member **2300** (and to the flange **2214**) via the second movable member **2345**. Thus, when the medicament container **2200** is moved from its first position to its second position, the second movable member **2345** moves with the medicament container **2200** and/or the first movable member **2300**.

In some embodiments, the second portion **2338** can engage the second movable member **2345** to maintain a distance (e.g., an air gap, space, or void) between the second movable member **2345** and the plunger **2217**, when the medicament container **2200** is in the first configuration (FIG. **1**) and/or when the medicament container **2200** is moving between its first position and its second position. In this manner, any preload or residual force produced by the energy storage member **1400** on the second movable member **2345** is not transferred to the plunger **2217**. Said another way, the plunger **2217** is substantially isolated from the energy storage member **2400** during the storage configuration and/or when the medicament container **2200** is moving. Accordingly, this arrangement reduces and/or eliminates medicament leakage from the medicament container **2200**.

When the medicament container **2200** in the second position (FIGS. **6** and **7**), the second portion **2338** of the first movable member **2300** is configured to deform (e.g., by a portion of the force F_3), thereby allowing movement of the second movable member **2345** relative to the first movable member **2300** and/or the medicament container **2200**. Thus, when the second portion **2338** of the first movable member **2300** deforms, at least a portion of the force F_3 is exerted upon the plunger **2217**. Similarly stated, when the medicament delivery device **2000** is in the second configuration (FIG. **6**), a portion of the force F_3 can deform the second portion **2338** of the movable member **2300** (FIG. **7**). After the second portion **2338** is deformed, at least a portion of the force F_3 is transmitted from the second movable member **2345** to the plunger **2217** to place the medicament container **2200** in the third configuration (FIG. **7**). More specifically, when the second portion **2338** deforms, the second movable member **2345** moves in the direction of the arrow EE (FIG. **7**) and moves the plunger **2217** from the proximal end portion **2212** of the medicament container **2200** toward the distal end portion **2213** of the medicament container **2200**. Similarly stated, when the second portion **2338** deforms, the second movable member **2345** moves relative to the medicament container **2200** to move the plunger **2217** within the medicament container **2200**. This arrangement allows for the delivery of the medicament contained within the medicament container **2200** into a body of a patient, as shown in FIG. **8**.

In some embodiments, the medicament delivery device **2000** can include a retraction member (not shown in FIGS. **5-8**). The retraction member can be any suitable device and/or mechanism configured to move the medicament container **2200** from the second position (e.g., the fourth configuration shown in FIG. **8**) toward the first position (e.g. the first configuration shown in FIG. **5**). In some embodiments, the retraction member can be substantially similar to the retraction member **1351** described with respect to FIGS. **1-4**. In such embodiments, the retraction member can be configured to transmit a force to the flange **2214** of the medicament container **2200** and move the medicament container **2200** in a second direction opposite the first direction indicated by the arrow DD in FIG. **6**.

In some embodiments, the medicament delivery device can be a medical injector configured to automatically deliver a medicament contained within a medicament container, such as, for example a prefilled syringe. For example, FIGS. **9-55** show a medical injector **3000**, according to an embodiment. FIGS. **9-10** are perspective views of the medical injector **3000** in a first configuration (i.e., prior to use). The medical injector **3000** includes a housing **3100** (see e.g., FIGS. **11-17**), a system actuation assembly **3500** (see e.g., FIGS. **18-21**), a medicament container **3200** containing a medicament **3220** (see e.g., FIG. **22**), a medicament delivery mechanism **3300** (see e.g., FIG. **26-28**), an electronic circuit system **3900** (see e.g., FIGS. **29-39**), a cover **3190** (see e.g., FIGS. **40-41**), and a safety lock **3700** (see e.g., FIGS. **42-46**). A discussion of the components of the medical injector **3000** will be followed by a discussion of the operation of the medical injector **3000**.

As shown in FIGS. **11-17**, the housing **3100** has a proximal end portion **3101** and a distal end portion **3102**. The housing **3100** defines a first status indicator aperture **3130** and a second status indicator aperture **3160**. The first status indicator aperture **3130** defined by the housing **3100** is located on a first side of the housing **3100**, and the second status indicator aperture **3160** of the housing **3100** is located on a second side of the housing **3100**. The status indicator apertures **3130**, **3160** can allow a patient to monitor the status and/or contents of the medicament container **3200** contained within the housing **3100**. For example, by visually inspecting the status indicator apertures **3130**, **3160**, a patient can determine whether the medicament container **3200** contains a medicament **3220** and/or whether the medicament **3220** has been dispensed.

As shown in FIGS. **15** and **16**, the housing **3100** defines a gas cavity **3151**, a medicament cavity **3139** and an electronic circuit system cavity **3137**. The gas cavity **3151** has a proximal end portion **3152** and a distal end portion **3153**. The gas cavity **3151** is configured to receive the gas container **3410** and a portion of the system actuator assembly **3500** (e.g., a release member **3550** and the spring **3576**, as shown in FIGS. **18** and **19**) as described in further detail herein. The proximal end portion **3152** of the gas cavity **3151** is configured to receive the gas container retention member **3580** of a proximal cap **3103** of the housing **3100**, as described in further detail herein. The gas cavity **3151** is in fluid communication with the medicament cavity **3139** via a gas passageway **3156** (see e.g., FIG. **17**), as described in further detail herein, and the gas cavity **3151** is in fluid communication with a region outside the housing **3100** via a release member aperture **3154** (see e.g., FIGS. **15** and **16**).

The medicament cavity **3139** is configured to receive the medicament container **3200** and at least a portion of the medicament delivery mechanism **3300**. In particular, as described below, the medicament delivery mechanism **3300** includes a carrier **3370** and piston member **3330** movably disposed in the medicament cavity **3139**. The medicament cavity **3139** is in fluid communication with a region outside the housing **3100** via a needle aperture **3105** (see e.g., FIGS. **15** and **16**).

The electronic circuit system cavity **3137** is configured to receive the electronic circuit system **3900**. The housing **3100** has protrusions **3136** (see e.g., FIG. **14**) configured to stabilize the electronic circuit system **3900** when the electronic circuit system **3900** is disposed within the electronic circuit system cavity **3137**. The outer surface of the housing **3100** is configured to receive a set of connection protrusions **3174**A and connection protrusion **3177**B of the electronic circuit system **3900** (see e.g., FIG. **32**). In this manner, the electronic circuit system **3900** can be coupled to the housing **3100** within the electronic circuit system cavity **3137**. In other embodiments, the electronic circuit system **3900** can be coupled within the electronic circuit system cavity **3137** by other suitable means such as an adhesive, a clip, a label and/or the like.

The electronic circuit system cavity **3137** is fluidically and/or physically isolated from the gas cavity **3151** and/or the medicament cavity **3139** by a sidewall **3150**. The sidewall **3150** can be any suitable structure to isolate the electronic circuit system cavity **3137** within the housing **3100** from the gas cavity **3151** and/or the medicament cavity **3139** within the housing **3100**. Similarly, the gas cavity **3151** and the medicament cavity **3139** are separated by a sidewall **3155** (see FIG. **16**). In some embodiments, sidewall **3155** can be similar to the sidewall **3150**, which isolates the gas cavity **3151** and the medicament cavity **3139** from the electronic circuit system cavity **3137**. In other embodiments, the gas cavity **3151** can be fluidically and/or physically isolated from the medicament cavity **3139** by any suitable means. In yet other embodiments, the medicament cavity **3139** need not be fluidically and/or physically isolated from the electronic circuit system cavity **3137** and/or the gas cavity **3151**.

The proximal end portion **3101** of the housing **3100** includes a proximal cap **3103** (see e.g., FIG. **17**), a speaker protrusion **3138** (see e.g., FIGS. **14-16**), and cover retention protrusions **3104** (see e.g., FIGS. **10** and **12**). The speaker protrusion **3138** is configured to maintain a position of an audio output device **3956** of the electronic circuit system **3900** relative to the housing **3100** when the electronic circuit system **3900** is attached to the housing **3100**, as described herein. The cover retention protrusions **3104** are configured to be received within corresponding openings **3193** defined by the cover **3190** (see e.g., FIG. **10**) to retain the cover **3190** about the housing **3100**. In this manner, as described in more detail herein, the cover **3190** is removably coupled to and disposed about at least a portion of the housing **3100**.

As shown in FIG. **17**, the proximal cap **3103** includes a gas container retention member **3580** and defines a gas passageway **3156**. The gas container retention member **3580** is configured to receive and/or retain a gas container **3410** that contains a pressurized gas, as shown in FIG. **18**. When the medical injector **3000** is actuated, pressurized gas from the gas container **3140** is conveyed from the gas cavity **3151** to the medicament cavity **3139** via the gas passageway **3156**, as further described herein. Said another way, the gas passageway **3156** places the gas cavity **3151** in fluid communication with the medicament cavity **3139**.

As shown in FIGS. **13** and **15**, the distal end portion **3102** of the housing **3100** defines a battery isolation protrusion aperture **3135**, a needle aperture **3105**, a safety lock actuator groove **3133**, a release member contact surface **3126**, a release member aperture **3154**, a base protrusion groove **3132**, base retention recesses **3134**A, **3134**B, and base rail grooves **3114**. The battery isolation protrusion aperture **3135**

receives the battery isolation protrusion **3197** of the cover **3190** (see e.g., FIG. **41**) when the cover **3190** is disposed about at least a portion of the housing **3100**. The needle aperture **3105** is the opening through which the needle **3216** is disposed (see e.g., FIGS. **19**, **51** and **52**) when the medical injector **3000** is actuated, as described in further detail herein.

The safety lock actuator groove **3133** receives an actuator **3724** of the safety lock **3700** (see e.g., FIG. **43**). As described in more detail herein, the actuator **3724** is configured to engage and/or activate the electronic circuit system **3900** when the safety lock **3700** is moved with respect to the housing **3100**. The release member contact surface **3126** defines the release member aperture **3154**. As shown in FIG. **21** and described in more detail below, the release member aperture **3154** receives a distal end portion **3552** of a release member **3550**. As described in more detail below, a safety lock protrusion **3702** (see e.g., FIG. **42**) is disposed within an opening **3556** between extensions **3553** of the release member **3550** (see e.g., FIGS. **19** and **21**) such that an engagement surface **3554** of the extensions **3553** is engaged with the release member contact surface **3126** to prevent activation of the medical injector **3000**. The safety lock **3700**, its components and functions are described in more detail below.

The distal base retention recesses **3134**A are configured to receive the base connection knobs **3518** of the actuator **3510** (also referred to herein as "base **3510**," see e.g., FIG. **47**) when the base **3510** is in a first position relative to the housing **3100**. The proximal base retention recesses **3134**B are configured to receive the base connection knobs **3518** of the base **3510** when the base **3510** is in a second position relative to the housing **3100**. The base retention recesses **3134**A, **3134**B have a tapered proximal sidewall and a non-tapered distal sidewall. This allows the base retention recesses **3134**A, **3134**B to receive the base connection knobs **3518** such that the base **3510** can move proximally relative to the housing **3100**, but cannot move distally relative to the housing **3100**. Said another way, the distal base retention recesses **3134**A are configured to prevent the base **3510** from moving distally when the base **3510** is in a first position and the proximal base retention recesses **3134**B are configured to prevent the base **3510** from moving distally when the base **3510** is in a second position. Similarly stated, the proximal base retention recesses **3134**B and the base connection knobs **3518** cooperatively to limit movement of the base to prevent undesirable movement of the base **3510** after the medical injector **3000** is actuated. The proximal base retention recesses **3134**B and the base connection knobs **3518** also provide a visual cue to the user that the medical injector **3000** has been used.

The base actuator groove **3132** receives a protrusion **3520** of the base **3510**. As described in more detail herein, the protrusion **3520** of the base **3510** is configured to engage the electronic circuit system **3900** when the base **3510** is moved with respect to the housing **3100**. The base rail grooves **3114** receive the guide members **3517** of the base **3510** (see FIG. **47**). The guide members **3517** of the base **3510** and the base rail grooves **3114** of the housing **3100** engage each other in a way that allows the guide members **3517** of the base **3510** to slide in a proximal and/or distal direction within the base rail grooves **3114** while limiting lateral movement of the guide members **3517**. This arrangement allows the base **3510** to move in a proximal and/or distal direction with respect to the housing **3100** but prevents the base **3510** from moving in a lateral direction with respect to the housing **3100**.

FIGS. **18-28** show the medicament container **3200**, the system actuator assembly **3500** and the medicament delivery mechanism **3300** of the medical injector **3000**. The medicament container **3200** has a body **3210** with a distal end portion **3213** and a proximal end portion **3212**. The body **3210** defines a volume that contains (i.e., is filled with or partially filled with) a medicament **3220** (see, e.g., FIGS. **22** and **28**). The distal end portion **3213** of the medicament container **3200** includes a neck **3215** that is coupled to the needle **3216**, as described below. The proximal end portion **3212** of the medicament container **3200** includes an elastomeric member **3217** (i.e., a plunger) that seals the medicament **3220** within the body **3210**. The elastomeric member **3217** is configured to move within the body to inject the medicament **3220** from the medicament container **3200**. More particularly, as shown in FIG. **27**, the elastomeric member **3217** is configured to receive and/or contact a piston rod **3333** of a piston member **3330** (also referred to herein as "second movable member **3330**") of the medicament delivery mechanism **3300**.

The elastomeric member **3217** can be of any design or formulation suitable for contact with the medicament **3220**. For example, the elastomeric member **3217** can be formulated to minimize any reduction in the efficacy of the medicament **3220** that may result from contact (either direct or indirect) between the elastomeric member **3217** and the medicament **3220**. For example, in some embodiments, the elastomeric member **3217** can be formulated to minimize any leaching or out-gassing of compositions that may have an undesired effect on the medicament **3220**. In other embodiments, the elastomeric member **3217** can be formulated to maintain its chemical stability, flexibility and/or sealing properties when in contact (either direct or indirect) with the medicament **3220** over a long period of time (e.g., for up to six months, one year, two years, five years or longer).

In some embodiments, the elastomeric member **3217** can be constructed from multiple different materials. For example, in some embodiments, at least a portion of the elastomeric member **3217** can be coated. Such coatings can include, for example, polydimethylsiloxane. In some embodiments, at least a portion of the elastomeric member **3217** can be coated with polydimethylsiloxane in an amount of between approximately 0.02 mg/cm^2 and approximately 0.80 mg/cm^2.

The proximal end portion **3212** of the body **3210** includes a flange **3214** configured to be disposed within a portion of the carrier **3370** (also referred to as a first movable member **3370**), as described in further detail herein. The flange **3214** can be of any suitable size and/or shape. Although shown as substantially circumscribing the body **3210**, in other embodiments, the flange **3214** can only partially circumscribe the body **3210**.

The medicament container **3200** can have any suitable size (e.g., length and/or diameter) and can contain any suitable volume of the medicament **3220**. Moreover, the medicament container **3200** and the second movable member **3330** can be collectively configured such that the second movable member **3330** travels a desired distance within the medicament container **3200** (i.e., the "stroke") during an injection event. In this manner, the medicament container **3200**, the volume of the medicament **3220** within the medicament container **3200** and the second movable member **3330** can be collectively configured to provide a desired fill volume and delivery volume. For example, the medicament container **3200**, as shown in FIG. **22**, is a prefilled syringe having a predetermined fill volume. Based on the predetermined fill volume, the second movable member **3330** can be configured to provide a desired delivery volume.

Moreover, the length of the medicament container **3200** and the length of the second movable member **3330** can be configured such that the medicament delivery mechanism **3300** can fit within the same housing **3100** regardless of the

fill volume, the delivery volume and/or the ratio of the fill volume to the delivery volume. In this manner, the same housing and production tooling can be used to produce devices having various dosages of the medicament **3220**. For example, in a first embodiment (e.g., having a fill volume to delivery volume ratio of 0.4), the medicament container has a first length and the second movable member has a first length. In a second embodiment (e.g., having a fill volume to delivery volume ratio of 0.6), the medicament container has a second length shorter than the first length, and the second movable member has a second length longer than the first length. In this manner, the stroke of the device of the second embodiment is longer than that of the device of the first embodiment, thereby allowing a greater dosage. The medicament container of the device of the second embodiment, however, is shorter than the medicament container of the device of the first embodiment, thereby allowing the components of both embodiments to be disposed within the same housing and/or a housing having the same length.

As shown in FIGS. **18-21**, the system actuator assembly **3500** includes the base **3510**, a release member **3550** and a spring **3576**. FIG. **19** shows certain internal components of the medical injector **3000** without the base **3510** and the spring **3576** so that the release member **3550** can be more clearly shown.

The release member **3550** has a proximal end portion **3551** and a distal end portion **3552**, and is movably disposed within the distal end portion **3153** of the gas cavity **3151**. The proximal end portion **3551** of the release member **3550** includes a sealing member **3574** and a puncturer **3575**. The sealing member **3574** is configured to engage the sidewall of the housing **3100** defining the gas cavity **3151** such that the proximal end portion **3152** of the gas cavity **3151** is fluidically isolated from the distal end portion **3153** of the gas cavity **3151**. In this manner, when gas is released from the gas container **3410**, the gas contained in the proximal end portion **3152** of the gas cavity **3151** is unable to enter the distal end portion **3153** of the gas cavity **3151**. The puncturer **3575** of the proximal end portion **3551** of the release member **3550** is configured to contact and puncture a frangible seal **3413** on the gas container **3410** when the release member **3550** moves proximally within the gas cavity **3151**, as shown by the arrow FF in FIG. **19**.

The distal end portion **3552** of the release member **3550** includes extensions **3553**. The extensions **3553** have projections **3555** that include tapered surfaces **3557** and engagement surfaces **3554**. Further, the extensions **3553** define an opening **3556** between the extensions **3553**. The engagement surfaces **3554** of the projections **3555** are configured to extend through the release member aperture **3154** of the housing **3100** and contact the release member contact surface **3126** of the housing **3100**, as shown in FIG. **21**. In this manner, the engagement surfaces **3554** of the projections **3555** limit proximal movement of the release member **3550** when the engagement surfaces **3554** are in contact with the release member contact surface **3126** of the housing **3100**.

The opening **3556** defined by the extensions **3553** is configured to receive the safety lock protrusion **3702** of the safety lock **3700** (see e.g., FIGS. **21** and **42**) when the safety lock **3700** is coupled to the housing **3100** and/or the base **3510**. The safety lock protrusion **3702** is configured to prevent the extensions **3553** from moving closer to each other. Said another way, the safety lock protrusion **3702** is configured to ensure that the extensions **3553** remain spaced apart and the engagement surfaces **3554** of the projections **3555** remain in contact with the release member contact surface **3126** of the housing **3100**. In some embodiments, for example, the release member **3550** and/or the extensions **3553** can be constructed from any suitable material configured to withstand deformation that may occur when exposed to a load over an extended period of time. In some embodiments, for example, the release member **3550** and/or the extensions **3553** can be constructed from brass.

The tapered surfaces **3557** of the projections **3555** are configured to contact tapered surfaces **3522** of contact protrusions **3515** on a proximal surface **3511** of the base **3510** (see e.g., FIGS. **21** and **47**) when the base **3510** is moved proximally relative to the housing **3100**. Accordingly, when the base **3510** is moved proximally relative to the housing **3100**, the extensions **3553** are moved together by the tapered surfaces **3522** of the contact protrusions **3515**. The inward movement of the extensions **3553** causes the release member **3550** to disengage the release member contact surface **3126** of the housing **3100**, thereby allowing the release member **3550** to be moved proximally along its longitudinal axis as the spring **3576** expands.

The medicament delivery mechanism **3300** includes a gas container **3410**, the carrier **3370** (also referred to herein as the first movable member **3370**), the piston member **3330** (also referred to herein as the second movable member **3330**), and a retraction spring **3351**. As described above, the carrier **3370** and the piston member **3330** are each movably disposed within the medicament cavity **3139** of the housing **3100**. The gas container **3410** is disposed within the gas cavity **3151** of the housing **3100**.

The gas container **3410** includes a distal end portion **3411** and a proximal end portion **3412**, and is configured to contain a pressurized gas. The distal end portion **3411** of the gas container **3410** contains a frangible seal **3413** configured to break when the puncturer **3575** of the proximal end portion **3551** of the release member **3550** contacts the frangible seal **3413**. The gas container retention member **3580** of the proximal cap **3103** of the housing **3100** is configured to receive and/or retain the proximal end portion **3412** of the gas container **3410**. Said another way, the position of the gas container **3410** within the gas cavity **3151** is maintained by the gas container retention member **3580**. As shown in FIGS. **18** and **19**, the length of the gas container retention member **3580** and the length of the release member **3550** collectively determine the distance between the puncturer **3575** and the frangible seal **3413** when the medical injector **3000** is in the storage configuration. Accordingly, this distance, which is the distance through which the puncturer **3575** travels when the medical injector **3000** is actuated, can be adjusted by changing the length of the gas container retention member **3580** and/or the length of the release member **3550**. In some embodiments, the actuation time and/or the force exerted by the puncturer **3575** on the frangible seal **3413** can be adjusted by changing the distance between the puncturer **3575** and the frangible seal **3413**.

As shown in FIGS. **26** and **52**, the piston member **3330** includes a piston rod **3333**, and has a proximal end portion **3331** and a distal end portion **3332**. The proximal end portion **3331** includes a sealing member **3339**. The sealing member **3339** engages the sidewall of the housing **3100** to define a gas chamber (i.e., a volume within the medicament cavity **3139** between the proximal end of the housing **3100** and the proximal end of the piston member **3330**) that receives the pressurized gas from the gas container **3410**. The sealing member **3339** can be any suitable structure and or component to produce a substantially fluid-tight seal between the sidewall of the housing **3100** and the piston member **3330**. The proximal end portion **3331** also includes a gas relief valve **3340** (see e.g., FIGS. **26** and **53-55**) configured to be selectively actu-

ated to allow fluid communication between the gas chamber and a volume outside of the gas chamber (e.g., the distal end portion of the medicament cavity **3139**). As described in more detail below, the gas relief valve **3340** allows the gas pressure within the gas chamber to be reduced upon completion of the injection event.

Referring to FIG. **27**, the distal end portion **3332** includes a first surface **3341** and a second surface **3342**. The second surface **3342** is disposed through a piston rod opening **3384** of the carrier **3370** and within the proximal end portion **3212** of the medicament container **3200**. The first surface **3341** is configured to contact a proximal surface **3378** of an engagement portion **3379** of the carrier **3370** when the medicament injector **3000** is in a first configuration (i.e., when the medicament container **3200** is in its first position). The distance between the first surface **3341** and the second surface **3342** is such that when the first surface **3341** is in contact with the engagement portion **3379** of the carrier **3370**, the second surface **3342** is spaced apart from the elastomeric member **3217** within the medicament container **3200** (see e.g., FIG. **27**). This arrangement limits any preload and/or residual force applied to the piston member **3330** (e.g., via the retraction spring **3351** and/or the pressurized gas) from being transferred to the plunger **3217**. Said another way, the plunger **3217** is isolated from the piston member **3330** during the storage configuration and/or when the medicament container **3200** is moving distally within the housing **3100**. Accordingly, this arrangement reduces and/or eliminates leakage of the medicament **3220** from the medicament container **3200**.

As described in more detail herein, the piston member **3330** is configured to move within the medicament container **3200**. Because the first surface **3341** is configured to contact the engagement portion **3379**, the piston member **3330** applies a force to the proximal surface **3378** of the first shoulder **3377** such that the carrier **3370** and the piston member **3330** move together within the medicament cavity **3139**. Moreover, when the medicament container **3200** is in its second position, the piston member **3330** can move relative to the carrier **3370** and/or the medicament container **3200** such that the second surface **3342** engages and/or contacts the elastomeric member **3217** to convey the medicament **3220** contained in the medicament container **3200**. The piston member **3330** can be constructed of a resilient, durable and/or sealing material or combination of materials, such as a rubber.

The carrier **3370** of the medicament delivery mechanism **3300** includes a distal end portion **3372**, a proximal end portion **3371**, a first side portion **3373**, a second side portion **3374** and a hinge portion **3375** (see e.g., FIGS. **23-28**). The first side portion **3373** includes latch protrusions **3383** configured to be coupled to the corresponding latches **3376** of the second side portion **3374**. The second side portion **3374** is configured to move relative to the first side portion **3373** via the hinge portion **3375** between an opened configuration (FIGS. **23** and **24**) and a closed configuration (FIG. **25**). This arrangement allows at least the proximal end portion **3212** of the medicament container **3200** to be disposed within (and/or removed from) the carrier **3370** when the carrier **3370** is in the opened configuration (see e.g., FIGS. **23** and **24**). When the carrier **3370** is in the closed configuration (see e.g., FIGS. **25-28**), the latches **3376** of the second side portion **3374** engage the latch protrusions **3383** of the first side portion **3373** to maintain the medicament container **3200** within the carrier **3370**.

The proximal end portion **3371** of the carrier **3370** includes a first shoulder **3377** and a second shoulder **3381** that collectively define a flange groove **3385**. The flange groove **3385** is configured to receive the flange **3214** of the proximal end portion **3212** of the medicament container **3200** (see e.g., FIG. **26**). More particularly, the first shoulder **3377** is defined by the first side portion **3373**, and the second shoulder **3381** is defined by portions of both the first side portion **3373** and the second side portion **3374**. In this manner, the first shoulder **3377** is configured to contact a proximal surface of the flange **3214**, either directly or via intervening structure (e.g., an o-ring, a damping member, or the like). Similarly, the second shoulder **3381** is configured to contact a distal surface of the flange **3214**, either directly or via intervening structure (e.g., an o-ring, a damping member, or the like). In this manner, as described in more detail below, the first shoulder **3377** can transfer at least a portion of a distal force (i.e., an insertion force) to the flange **3214** to produce distal movement of the carrier **3370** and/or the medicament container **3200** within the housing **3100**. The second shoulder **3381** can transfer at least a portion of a proximal force (i.e., a retraction force) to the flange **3214** to produce proximal movement of the carrier **3370** and/or the medicament container **3200** within the housing **3100**.

The second side portion **3374** includes a protrusion **3386** configured to contact a surface of the first side portion **3373** when the carrier **3370** is in the closed configuration (FIG. **25**). In this manner, the protrusion **3386** and the corresponding portion of the first side portion **3373** limits the movement of the second side portion **3374** relative to the first side portion **3373** when the carrier **3370** is in the closed configuration. Similarly stated, the protrusion **3386** of the second side portion **3374** contacts the first side portion **3373** to prevent the carrier **3370** from squeezing the medicament container **3200**, when the carrier **3370** is in the closed configuration.

The second side portion **3374** includes a latch **3387** having a protrusion **3388**. The protrusion **3388** of the latch **3387** is configured to engage a retraction lock protrusion **3162** defined by the sidewall of the housing **3100** defining the medicament cavity **3139** (see e.g., FIG. **28**) when the carrier **3370** and the medicament container **3200** are in the first (i.e., storage) position. This arrangement allows the medicament delivery mechanism **3300** (e.g., the carrier **3370**, the piston member **3330**) and the medicament container **3200** to move in the distal direction within the housing **3100** but limits the movement of the carrier **3370** and the medicament container **3200** in the proximal direction. In this manner, the preload of the retraction spring **3351** is not transferred to the piston member **3330** and/or the engagement portion **3379** of the carrier **3370**. Similarly stated, this arrangement prevents the medicament delivery mechanism **3300** from moving in the proximal direction when the medical injector **3000** is in the first configuration. This arrangement also limits proximal motion of the medicament delivery mechanism **3300** during assembly (e.g., when the needle sheath is being pressed about the needle).

As described above, the carrier **3370** includes the engagement portion **3379** configured to engage the first surface **3341** of the piston member **3330**. The first shoulder **3377** is in contact with the proximal surface of the flange **3214** and therefore transmits a force from the piston member **3330** to move the medicament container **3200** from a first position to a second position when the medicament injector **3000** is actuated.

As shown in FIG. **26**, the carrier **3370** also includes an engagement portion **3382** configured to engage the retraction spring **3351**. Although the engagement portion **3382** is shown as including a protrusion about which a portion of the retraction spring **3351** is disposed, in other embodiments, the engagement portion **3382** can include any suitable features for engaging and/or retaining the retraction spring **3351** (e.g.,

a recess). The second shoulder **3381** is configured to engage the distal end of the flange **3214** and therefore transmits a retraction force produced by the retraction spring **3351** to move the medicament container **3200** from the second position toward the first position.

A proximal surface **3378** of the first shoulder **3377** of the carrier **3370** includes a gas valve actuator **3380**. The gas valve actuator **3380** is configured to engage the gas relief valve **3340** (see e.g., FIG. **26**) of the piston member **3330** to allow the pressurized gas contained within the gas chamber (i.e., the volume within the medicament cavity **3139** between the proximal end of the housing **3100** and the proximal end of the piston member **3330**) to escape when the injection event is complete. Thus, after the gas pressure within the medicament cavity **3139** decreases below a certain level, the force exerted by the retraction spring **3351** on the carrier **3370** is sufficient to cause the carrier **3370** to move proximally within the housing **3100** (i.e., to retract). In addition, this arrangement results in there being substantially no residual force (from the pressurized gas) within the housing, which decreases stress on the components after the injection event.

FIGS. **29-39** show the electronic circuit system **3900**. The electronic circuit system **3900** of the medical injector **3000** includes an electronic circuit system housing **3170**, a printed circuit board **3922**, a battery assembly **3962**, an audio output device **3956**, two light emitting diodes (LEDs) **3958**A, **3958**B and a battery clip **3910**. As shown in FIG. **36**, the electronic circuit system **3900** is disposed within the electronic circuit system cavity **3137** of the housing **3100**. As described herein, the electronic circuit system **3900** is configured to output an electronic output associated with the use of the medical injector **3000**.

The electronic circuit system housing **3170** of the electronic circuit system **3900** includes a distal end portion **3172** and a proximal end portion **3171**. The proximal end portion **3171** includes connection protrusions **3174**A and a battery clip protrusion **3176** (see e.g., FIG. **33**). The connection protrusions **3174**A are configured to matingly engage a surface of the sidewalls of the housing **3100** that define the electronic cavity **3137**, as described above. In this manner, the electronic circuit system **3900** can be coupled to the housing **3100** within the electronic circuit system cavity **3137**. In other embodiments, the electronic circuit system **3900** can be coupled to the housing **3100** by other suitable means such as an adhesive, a clip, a label and/or the like. As described in more detail herein, the battery clip protrusion **3176** is configured to hold the battery clip **3910** in place.

The proximal end portion **3171** of the electronic circuit system housing **3170** defines multiple sound apertures **3173**. The audible output device **3956** is disposed against the proximal end portion **3171** of the electronic circuit system housing **3170** such that the front face of the audible output device **3956** is disposed adjacent the sound apertures **3173**. In this manner, the sound apertures **3173** are configured to allow sound produced by the audio output device **3956** to pass from the audio output device **3956** to a region outside of the housing **3100**.

As shown in FIGS. **32** and **33**, the distal end portion **3172** of the electronic circuit system housing **3170** includes the connection protrusion **3174**B, a stiffening protrusion **3177** and defines an LED aperture **3178**, apertures **3175**, a safety lock actuator groove **3179** and a base actuator groove **3180**. The LED aperture **3178** is configured to receive the LEDs **3958**A, **3958**B such that a user can view the LEDs **3958**A, **3958**B, which are described in more detail herein.

The connection protrusion **3174**B extends from the distal end portion **3172** of the electronic circuit system housing **3170**, and is configured to attach the electronic circuit system **3900** to the housing **3100**, as described above. The stiffening protrusion **3177** is configured to have at least a portion received within and/or accessible via the apertures **3175** defined by the housing **3100** (see e.g., FIG. **11**). The stiffening protrusion **3177** is configured to limit the bending (e.g., buckling) of the electronic circuit system housing **3170** when the electronic circuit system housing **3170** is coupled to the housing **3100**. Moreover, a user can access the stiffening protrusion **3177** via the apertures **3175**. In this manner, for example, the user can disengage the stiffening protrusion **3177** from the apertures **3175**.

The safety lock actuator groove **3179** of the electronic circuit system housing **3170** is configured to be disposed adjacent the safety lock actuator groove **3133** of the distal end portion **3102** of the housing **3100**. In this manner, the safety lock actuator groove **3179** of the electronic circuit system housing **3170** and the safety lock actuator groove **3133** of the distal end portion **3102** of the housing **3100** collectively receive the actuator **3724** of the safety lock **3700**, which is described in more detail herein. Similarly, the base actuator groove **3180** of the electronic circuit system housing **3170** is configured to be disposed adjacent the base actuator groove **3132** of the distal end portion **3102** of the housing **3100**. The base actuator groove **3180** of the electronic circuit system housing **3170** and the base actuator groove **3132** of the distal end portion **3102** of the housing **3100** collectively receive the protrusion **3520** of the base **3510**, which is described in more detail herein.

The printed circuit board **3922** of the electronic circuit system **3900** includes a substrate **3924**, a first actuation portion **3926** and a second actuation portion **3946**. The substrate **3924** of the printed circuit board **3922** includes the electrical components for the electronic circuit system **3900** to operate as desired. For example, the electrical components can be resistors, capacitors, inductors, switches, microcontrollers, microprocessors and/or the like. The printed circuit board may also be constructed of materials other than a flexible substrate such as a FR4 standard board (rigid circuit board).

As shown in FIGS. **37-39**, the first actuation portion **3926** includes a first electrical conductor **3934** and defines an opening **3928** having a boundary **3929**. The opening **3928** of the first actuation portion **3926** is configured to receive a protrusion **3726** of the actuator **3724** of the safety lock **3700**. The boundary **3929** of the first opening **3928** has a discontinuous shape, such as, for example, a teardrop shape, that includes a stress concentration riser **3927**. The discontinuity and/or the stress concentration riser **3927** of the boundary **3929** can be of any suitable shape to cause the substrate **3924** to deform in a predetermined direction when the protrusion **3726** of the actuator **3724** of the safety lock **3700** is moved relative to the opening **3928**, as shown by the arrow GG in FIG. **38**.

The opening **3928** is defined adjacent the first electrical conductor **3934** that electronically couples the components included in the electronic circuit system **3900**. The first electrical conductor **3934** includes a first switch **3972**, which can be, for example a frangible portion of the first electrical conductor **3934**. In use, when the safety lock **3700** is moved from a first position (see e.g., FIG. **37**) to a second position (see e.g., FIG. **38**), the actuator **3724** moves in a direction substantially parallel to a plane defined by a surface of the first actuation portion **3926** of the substrate **3924**. The movement of the actuator **3724** causes the protrusion **3726** to move within the first opening **3928**, as indicated by the arrow GG in FIG. **38**. The movement of the protrusion **3726** tears the first actuation portion **3926** of the substrate **3924**, thereby separating the portion of the first electrical conductor **3934** including the first switch **3972**. Said another way, when the safety

lock **3700** is moved from its first position to its second position (see e.g., FIG. **50**), the actuator **3724** moves irreversibly the first switch **3972** from a first state (e.g., a state of electrical continuity) to a second state (e.g., a state of electrical discontinuity). Said yet another way, when the safety lock **3700** is moved from its first position to its second position, the actuator **3724** disrupts the first electrical conductor **3934**.

The second actuation portion **3946** includes a second electrical conductor **3935** and defines an opening **3945**, having a boundary **3949** and a tear propagation limit aperture **3948**. As shown in FIGS. **36-39**, the opening **3945** of the second actuation portion **3946** is configured to receive a portion of an actuator **3520** of the base **3510**. The boundary **3949** of the opening **3945** has a discontinuous shape that includes a stress concentration riser **3947**. The discontinuity and/or the stress concentration riser **3947** of the boundary **3949** can be of any suitable shape to cause the substrate **3924** to deform in a predetermined direction when the actuator **3520** of the base **3510** is moved in a proximal direction relative to the opening **3945**, as shown by the arrow HH in FIG. **39**.

The second electrical conductor **3935** includes a second switch **3973** disposed between the opening **3945** and the tear propagation limit aperture **3948**, which can be, for example, a frangible portion of the second electrical conductor **3935**. In use, when the base **3510** is moved from its first position to its second position (see e.g., FIG. **51**), the actuator **3520** moves in a proximal direction, substantially parallel to a plane defined by a surface of the second actuation portion **3946** of the substrate **3924**. The proximal movement of the actuator **3520** tears the second actuation portion **3946** of the substrate **3924**, thereby separating the portion of the second electrical conductor **3935** including the second switch **3973**. Said another way, when the base **3510** is moved from its first position to its second position, the actuator **3520** moves irreversibly the second switch **3973** from a first state (e.g., a state of electrical continuity) to a second state (e.g., a state of electrical discontinuity). The tear propagation limit aperture **3948** is configured to limit the propagation of the tear in the substrate **3924** in the proximal direction. Said another way, the tear propagation limit aperture **3948** is configured to ensure that the tear in the substrate **3924** does not extend beyond the tear propagation limit aperture **3948**. The tear propagation limit aperture **3948** can be any shape configured to stop the propagation of a tear and/or disruption of the substrate **3924**. For example, the tear propagation limit aperture **3948** can be oval shaped. In other embodiments, the proximal boundary of the tear propagation limit aperture **3948** can be reinforced to ensure that the tear in the substrate **3924** does not extend beyond the tear propagation limit aperture **3948**.

In some embodiments, the safety lock **3700** and base **3510** can be configured to interact with mechanical and/or optical switches to produce an electronic output in a reversible manner.

The battery assembly **3962** of the electronic circuit system **3900** includes two batteries stacked on top of one another. In other embodiments, the electronic circuit system can include any number of batteries and/or any suitable type of power source. In some embodiments, for example, the battery assembly can include Lithium batteries such as, for example, CR1616, CR2016s, type AAA or the like. The battery assembly **3962** has a first surface **3964** and a second surface **3966**. The first surface **3964** of the battery assembly **3962** can contact an electrical contact (not shown) disposed on the substrate **3924**. The second surface **3966** of the battery assembly **3962** is configured to contact a contact portion **3918** of a distal end portion **3916** of a battery clip **3910**. When both the electrical contact of the substrate **3924** and the contact portion **3918** of the distal end portion **3916** of the battery clip **3910** contact the battery assembly **3962**, the batteries of the battery assembly **3962** are placed in electrical communication with the electronic circuit system **3900**. Said another way, when the electrical contact of the substrate **3924** and the contact portion **3918** of the distal end portion **3916** of the battery clip **3910** contact the battery assembly **3962**, the battery assembly **3962** is configured to supply power to the electronic circuit system **3900**.

The battery clip **3910** (shown in FIG. **34**) includes a proximal end portion **3912** and a distal end portion **3916**. The proximal end portion **3912** defines a retention aperture **3913**. The retention aperture **3913** is configured to receive a screw **3911** to couple the battery clip **3910** to the battery clip protrusion **3176** of the electronic circuit system housing **3170**. In this manner, the battery clip protrusion **3176** maintains the position of the battery clip **3910** with respect to the electronic circuit system housing **3170** and/or the battery assembly **3962**.

The distal end portion **3916** of the battery clip **3910** includes a contact portion **3918** and an angled portion **3917**. As described above, the contact portion **3918** is configured to contact the second surface **3966** of the battery assembly **3962** to place the battery assembly **3962** in electrical communication with the electronic circuit system **3900**. The angled portion **3917** of the distal end portion **3916** of the battery clip **3910** is configured to allow a proximal end portion **3236** of a battery isolation protrusion **3197** (see e.g., FIG. **41**) to be disposed between the second surface **3966** of the battery assembly **3962** and the contact portion **3918** of the distal end portion **3916** of the battery clip **3910**. When the battery isolation protrusion **3197** is disposed between the second surface **3966** of the battery assembly **3962** and the contact portion **3918** of the distal end portion **3916** of the battery clip **3910**, the electrical path between the battery assembly **3962** and the remainder of the electrical circuit system **3900** is disrupted, thereby removing power from the electronic circuit system **3900**. The contact portion **3918** of the distal end portion **3916** of the battery clip **3910** is biased such that when the battery isolation protrusion **3197** is removed, the contact portion **3918** will move into contact the second surface **3966** of the battery assembly **3962**, thereby restoring electrical communication between the battery assembly **3962** and the electronic circuit system **3900**. In some embodiments, the battery isolation protrusion **3197** can be repeatedly removed from between the second surface **3966** of the battery assembly **3962** and the contact portion **3918** of the distal end portion **3916** of the battery clip **3910** and reinserted. Said another way, the battery isolation protrusion **3197** and the battery clip **3910** collectively form a reversible on/off switch.

The audio output device **3956** of the electronic circuit system **3900** is configured to output audible sound to a user in response to use of the medical injector **3000**. In some embodiments, the audible output device **3956** can be a speaker. In some embodiments, the audible sound can be, for example, associated with a recorded message and/or a recorded speech. In other embodiments, the audible instructions can be an audible beep, a series of tones and/or or the like.

In other embodiments, the medical injector **3000** can have a network interface device (not shown) configured to operatively connect the electronic circuit system **3900** to a remote device (not shown) and/or a communications network (not shown). In this manner, the electronic circuit system **3900** can send information to and/or receive information from the remote device. The remote device can be, for example, a remote communications network, a computer, a compliance

monitoring device, a cell phone, a personal digital assistant (PDA) or the like. Such an arrangement can be used, for example, to download replacement processor-readable code from a central network to the electronic circuit system **3900**. In some embodiments, for example, the electronic circuit system **3900** can download information associated with a medical injector **3000**, such as an expiration date, a recall notice, updated use instructions or the like. Similarly, in some embodiments, the electronic circuit system **3900** can upload information associated with the use of the medical injector **3000** via the network interface device (e.g., compliance information or the like).

FIGS. **40** and **41** show the cover **3190** of the medical injector **3000**. The cover **3190** includes a proximal end portion **3191** and a distal end portion **3192**, and defines a cavity **3196**. The cavity **3196** of the cover **3190** is configured to receive at least a portion of the housing **3100**. Thus, when the portion of the housing **3100** is disposed within the cover **3190**, the cover **3190** blocks an optical pathway between the medicament container **3200** and a region outside of the housing **3100**. Similarly stated, when the portion of the housing **3100** is disposed within the cover **3190**, the cover **3190** obstructs the first status indicator aperture **3130** and/or the second status indicator aperture **3160** of the housing **3100** to reduce the amount of light transmitted to the medicament **3220** within the medicament container **3200**. In this manner, the life of the medicament **3220** can be extended by the prevention and/or reduction of degradation to the medicament **3220** that may be caused by ultra-violet radiation. In other embodiments, however, such those containing a medicament that is not sensitive to ultraviolet (UV) radiation, the cover **3190** can include viewing windows and/or openings that substantially correspond to the aperture **3130** and/or the aperture **3160**.

The proximal end portion **3191** of the cover **3190** defines apertures **3193** configured to receive the cover retention protrusions **3104** of the housing **3100** (shown in FIGS. **10** and **12**). In this manner, the apertures **3193** and the cover retention protrusions **3104** of the housing **3100** removably retain the cover **3190** about at least a portion of the housing **3100**. Said another way, the apertures **3193** and the cover retention protrusions **3104** of the housing **3100** are configured such that the cover **3190** can be removed from a portion of the housing **3100** and then replaced about the portion of the housing **3100**.

As described above, the electronic circuit system **3900** can be actuated when the housing **3100** is at least partially removed from the cover **3190**. More particularly, the distal end portion **3192** of the cover **3190** includes the battery isolation protrusion **3197**. The battery isolation protrusion **3197** includes a proximal end portion **3236** and a tapered portion **3237**. The proximal end portion **3236** of the battery isolation protrusion **3197** is configured to be removably disposed between the second surface **3966** of the battery assembly **3962** and the contact portion **3918** of the distal end portion **3916** of the battery clip **3910**, as described above.

The cover **3190** can be any suitable configuration and can include any suitable feature. For example, the cover **3190** includes openings **3195** and notches **3194**. In some embodiments, the openings **3195** can receive inserts (not shown). The inserts can be flexible inserts and can increase friction between the cover **3190** and a surface. For example, the inserts can increase the friction between the cover **3190** and a surface on which the medical injector **3000** is placed, to prevent sliding. The notches **3194** are disposed at the proximal end of the cover **3190**. In some embodiments, the notches **3194** can be used to reduce the material needed to manufacture the cover **3190**.

FIGS. **42-46** show the safety lock **3700** of the medical injector **3000**. The safety lock **3700** of the medical injector **3000** includes a proximal surface **3730**, a distal surface **3740** opposite the proximal surface **3730** and a needle sheath **3810**. The safety lock **3700** defines a needle sheath aperture **3703** and a battery isolation protrusion aperture **3728**. The battery isolation protrusion aperture **3728** is configured to receive the battery isolation protrusion **3197** of the cover **3190** such that the battery isolation protrusion **3197** can be disposed within the electronic circuit system cavity **3137** and/or in engagement with the electronic circuit system **3900**, as described above. Similarly stated, the battery isolation protrusion aperture **3728** of the safety lock **3700** is aligned with the battery isolation protrusion aperture **3135** of the housing **3100**, such that the battery isolation protrusion **3197** can be disposed within the electronic circuit system cavity **3137** when the cover **3190** is disposed about a portion of the housing **3100**.

The proximal surface **3730** of the safety lock **3700** includes a safety lock protrusion **3702**, a stopper **3727**, an actuator **3724**, two opposing pull-tabs **3710** and an engagement portion **3720**. As described above, when the safety lock **3700** is in a first (locked) position, the safety lock protrusion **3702** is configured to be disposed in the opening **3556** defined by the extensions **3553** of the distal end portion **3552** of the release member **3550** (see e.g., FIG. **21**). Accordingly, the safety lock protrusion **3702** is configured to prevent the extensions **3553** from moving closer to each other, thereby preventing proximal movement of the release member **3550** and/or delivery of the medicament **3220**. The stopper **3727** of the safety lock **3700** is a protrusion extending from the proximal surface **3730** of the safety lock **3700**. The stopper **3727** is configured to contact a portion of the housing **3100** to limit the proximal movement of the safety lock **3700** relative to the housing **3100**. In other embodiments, the stopper **3727** can be any structure configured to limit the proximal movement of the safety lock **3700**.

The actuator **3724** of the safety lock **3700** has an elongated portion **3725** and a protrusion **3726**. The elongated portion **3725** extends in a proximal direction from the proximal surface **3730**. In this manner, the elongated portion **3725** can extend through a safety lock actuator opening **3524** of the base **3510** (see e.g., FIG. **47**) and within the safety lock actuator groove **3133** of the housing **3100** and the safety lock actuator groove **3179** of the electronic circuit system housing **3170**. The protrusion **3726** extends in a direction substantially transverse to the elongated portion **3725** and/or substantially parallel to the proximal surface **3730** of the safety lock **3700**. As described above, the opening **3928** of the first actuation portion **3926** of the printed circuit board **3922** is configured to receive the protrusion **3726** of the actuator **3724** of the safety lock **3700**.

The pull-tabs **3710** of the safety lock **3700** include a grip portion **3712** and indicia **3713**. The grip portion **3712** of the pull-tabs **3710** provides an area for the user to grip and/or remove the safety lock **3700** from the rest of the medicament delivery system **3700**. The indicia **3713** provide instruction on how to remove the safety lock **3700**. The distal end surface **3740** also includes indicia **3741** (see e.g., FIG. **44**). In some embodiments, for example, indicia can indicate the direction the user should pull the safety lock **3700** to remove the safety lock **3700**.

The engagement portion **3720** of the safety lock **3700** includes engagement members **3721**. The engagement members **3721** extend in a proximal direction from the proximal surface **3730**. The engagement members **3721** have tabs **3722** that extend from a surface of the engagement members **3721**.

The tabs **3722** are configured to engage an outer surface **3815** of a distal end portion **3812** of the needle sheath **3810**.

As shown in FIGS. **45** and **46**, the needle sheath **3810** includes the distal end portion **3812**, a proximal end portion **3811** and a rib **3816**. The needle sheath **3810** also defines a bore **3813**. The bore **3813** is defined by a contoured portion **3814** of the needle sheath **3810**, and is configured to receive the needle **3216** and/or a distal end portion of the **3213** of the medicament container **3200**. The inner portion of the needle sheath **3810** defines a friction fit with the distal end portion **3213** of the medicament container **3200**. In this manner, the needle sheath **3810** can protect the user from the needle **3216** and/or can keep the needle **3216** sterile before the user actuates the medical injector **3000**. The proximal end portion **3811** of the needle sheath is configured to contact the body **3210** of the medicament container **3200**.

The distal end portion **3812** of the needle sheath **3810** is configured to be inserted into a space defined between the tabs **3722** of the engagement members **3721** of the safety lock **3700**. The tabs **3722** are angled and/or bent towards the distal direction to allow the distal end portion **3812** of the needle sheath **3810** to move between the engagement members **3721** in a distal direction, but not in a proximal direction. Similarly stated, the tabs **3722** include an edge that contacts the outer surface **3815** of the needle sheath **3810** to prevent the safety lock **3700** from moving in a distal direction relative to the needle sheath **3810**. In this manner, the needle sheath **3810** is removed from the needle **3216** when the safety lock **3700** is moved in a distal direction with respect to the housing **3100** (see e.g., FIG. **50**).

FIGS. **47** and **48** show the base (or actuator) **3510** of the medical injector **3000**. The base **3510** includes a proximal surface **3511**, a distal surface **3523** and base connection knobs **3518**. The base **3510** defines a needle aperture **3513**, a safety lock protrusion aperture **3514**, a battery isolation protrusion aperture **3521**, a safety lock actuator opening **3524** and pull-tab openings **3519**. The needle aperture **3513** is configured to receive the needle **3216** when the medical injector **3000** is actuated. The safety lock protrusion aperture **3514** of the base **3510** receives the safety lock protrusion **3702** of the safety lock **3700** when the safety lock **3700** is coupled to the housing **3100** and/or the base **3510**. The battery isolation protrusion aperture **3521** of the base **3510** receives the battery isolation protrusion **3197** of the cover **3190** and the stopper **3727** of the safety lock **3700**. The safety lock actuator opening **3524** receives the safety lock actuator **3724** of the safety lock **3700**. The pull-tab openings **3519** are configured to receive the pull-tabs **3710** of the safety lock **3700**.

The proximal surface **3511** of the base **3510** includes a protrusion **3520**, guide members **3517** and protrusions **3515**. The protrusion **3520** is configured to engage the substrate **3924** of the electronic circuit system **3900**. As described above, the opening **3945** of the second actuation portion **3946** of the printed circuit board **3922** is configured to receive the actuator **3520** of the base **3510**. The guide members **3517** of the base **3510** engage and/or slide within the base rail grooves **3114** of the housing **3100**, as described above. The protrusions **3515** of the base **3510** engage the tapered surfaces **3557** of the extensions **3553** of the release member **3550**. As described in further detail herein, when the safety lock **3700** is removed and the base **3510** is moved in a proximal direction with respect to the housing **3100**, the protrusions **3515** of the base **3510** are configured to move the extensions **3553** of the release member **3550** closer to each other, actuating the medicament delivery mechanism **3300**. As described above, the base connection knobs **3518** engage the base retention recesses **3134**A, **3134**B in a way that allows proximal movement of the base **3510** but limits distal movement of the base **3510**.

As shown in FIG. **49**, the medical injector **3000** is first enabled by moving the medicament delivery device **3000** from a first configuration to a second configuration by moving the cover **3190** from a first position to a second position. The cover **3190** is moved from the first position to the second position by moving it with respect to the housing **3100** in the direction shown by the arrow II in FIG. **49**. When the cover **3190** is moved with respect to the housing **3100** in the direction II, the battery isolation protrusion **3197** is removed from the area between the battery clip **3910** and the second surface **3966** of the battery assembly **3962**. In this manner, the battery assembly **3962** is operatively coupled to the electronic circuit system **3900** when the cover **3190** is removed, thereby providing power to the electronic circuit system **3900**. Similarly stated, this arrangement allows the electronic circuit system **3900** to be actuated when the cover **3190** is removed.

When power is provided, as described above, the electronic circuit system **3900** can output one or more predetermined electronic outputs. For example, in some embodiments, the electronic circuit system **3900** can output an electronic signal associated with recorded speech to the audible output device **3956**. Such an electronic signal can be, for example, associated with a .WAV file that contains a recorded instruction, instructing the user in the operation of the medical injector **3000**. Such an instruction can state, for example, "Remove the safety tab near the base of the auto-injector." The electronic circuit system **3900** can simultaneously output an electronic signal to one and/or both of the LEDs **3958**A, **3958**B thereby causing one and/or both of the LEDs **3958**A, **3958**B to flash a particular color. In this manner, the electronic circuit system **3900** can provide both audible and visual instructions to assist the user in the initial operation of the medical injector **3000**.

In other embodiments, the electronic circuit system **3900** can output an electronic output associated with a description and/or status of the medical injector **3000** and/or the medicament **3220** contained therein. For example, in some embodiments, the electronic circuit system **3900** can output an audible message indicating the symptoms for which the medicament **3220** should be administered, the expiration date of the medicament **3220**, the dosage of the medicament **3220** or the like.

As described above, the medical injector **3000** can be repeatedly moved between the first configuration and the second configuration when the cover **3190** is moved repeatedly between the first position and the second position respectively. Said another way, the cover **3190** can be removed and replaced about the housing **3100** any number of times. When the cover **3190** is moved from the second position to the first position, the battery isolation protrusion **3197** is inserted between the battery clip **3910** and the second surface **3966** of the battery assembly **3962**, deactivating the electronic circuit system **3900**. When the cover is moved from the first position to the second position a second time, the electronic circuit system **3900** is once again activated. In this manner, the cover **3190** can be removed and the electronic circuit system **3900** can output an electronic output without compromising the sterility of the needle **3216**.

After the cover **3190** is removed from the housing **3100**, the medical injector **3000** can be moved from the second configuration (FIG. **49**) to a third configuration (FIG. **50**) by moving the safety lock **3700** from a first position to a second position. The safety lock **3700** is moved from a first position to a second position by moving the safety lock **3700** with

respect to the housing **3100** in the direction shown by the arrow JJ in FIG. **50**. When the safety lock **3700** is moved from the first position to the second position, the safety lock protrusion **3702** is removed from between the extensions **3553** of the release member **3550**, thereby enabling the medicament delivery mechanism **3300**. Moreover, as shown in FIGS. **37** and **38**, when the safety lock **3700** is moved from the housing **3100**, the actuator **3724** of the safety lock **3700** moves in the direction GG as shown in FIG. **38**, irreversibly moving the first switch **3972** from a first state (e.g., a state of electrical continuity) to a second state (e.g., a state of electrical discontinuity). When the actuator **3724** of the safety lock **3700** moves irreversibly the first switch **3972** of the electronic circuit system **3900** to the second state, the electronic circuit system **3900** can output one or more predetermined electronic outputs. For example, in some embodiments, a processor (not shown) can output an electronic signal associated with recorded speech to the audible output device **3956**. Such an electronic signal can be, for example, associated with a recorded message notifying the user of the status of the medical injector **3000**. Such a status message can state, for example, "If ready to use the medical injector, pull off the red safety guard." The electronic circuit system **3900** can also simultaneously output an electronic signal to one and/or both of the LEDs **3958**A, **3958**B, thereby causing one and/or both of the LEDs **3958**A, **3958**B to stop flashing, change color or the like.

In some embodiments, the first actuation portion **3926** and the actuator **3724** can be configured such that the actuator **3724** must move a predetermined distance before the actuator **3724** engages the boundary **3929** of the opening **3928**. For example, in some embodiments, the actuator **3724** must move approximately 0.200 inches before the actuator **3724** engages the boundary **3929** of the opening **3928**. In this manner, the safety lock **3700** can be moved slightly without irreversibly moving the first switch **3972** of the electronic circuit system **3900** to the second state. Accordingly, this arrangement will permit the user to inadvertently and/or accidentally move the safety lock **3700** without actuating the electronic circuit system **3900**.

In some embodiments, the electronic circuit system **3900** can be configured to output the status message for a predetermined time period, such as, for example, five seconds. After the predetermined time period has elapsed, the electronic circuit system **3900** can output an audible message further instructing the user in the operation of the medical injector **3000**. Such an instruction can state, for example, "Place the base of the auto-injector against the patient's thigh. To complete the injection, press the base firmly against the patient's thigh." In some embodiments, the electronic circuit system **3900** can simultaneously output an electronic signal to one and/or both of the LEDs **3958**A, **3958**B, thereby causing one and/or both of the LEDs **3958**A, **3958**B to flash a particular color. In this manner, the electronic circuit system **3900** can provide both audible and/or visual instructions to assist the user in the placement and actuation of the medical injector **3000**. In some embodiments, the electronic circuit system **3900** can be configured to repeat the instructions after a predetermined time period has elapsed.

As described above, in other embodiments, the medical injector **3000** can have a network interface device (not shown) configured to operatively connect the electronic circuit system **3900** to a remote device (not shown) and/or a communications network (not shown). In this manner, the electronic circuit system **3900** can send a wireless signal notifying a remote device that the safety lock **3700** of the medical injector **3000** has been removed and that the medical injector **3000** has been armed. In other embodiments, the electronic circuit system **3900** can send a wireless signal (e.g., a wireless 911 call) notifying an emergency responder that the medical injector **3000** has been armed, for example, via removal of the safety lock **3700**.

After the safety lock **3700** is moved from the first position to the second position, the medical injector **3000** can be moved from the third configuration (FIG. **50**) to a fourth configuration (FIG. **51**) by moving the base **3510** from a first position to a second position. Similarly stated, the medical injector **3000** can be actuated by the system actuator assembly **3500** by moving the base **3510** proximally relative to the housing **3100**. The base **3510** is moved from its first position to its second position by placing the medical injector **3000** against the body of the patient and moving the base **3510** with respect to the housing **3100** in the direction shown by the arrow KK in FIG. **51**. Moving the base **3510** from the first position to the second position causes the protrusions **3515** on the proximal surface **3511** of the base **3510** to engage the tapered surfaces **3557** of the extensions **3553** of the release member **3550**, thereby moving the extensions **3313** together. The inward movement of the extensions **3553** causes engagement surface **3554** of the release member **3550** to become disengaged from the base release surface **3126** of the housing **3100**, thereby allowing the release member **3550** to be moved proximally along its longitudinal axis as the spring **3576** expands.

When the base **3510** is moved from the first position to the second position, the system actuator assembly **3500** actuates the medicament delivery mechanism **3300**, thereby placing the medical injector **3000** in its fourth configuration (i.e., the needle insertion configuration), as shown in FIGS. **51** and **52**. More particularly, when the medical injector **3000** is in its fourth configuration, the puncturer **3575** of the release member **3550** is in contact with and/or disposed through the frangible seal **3413** of the gas container **3410**.

After the frangible seal **3413** has been punctured, an actuating portion of a compressed gas flows from the gas container **3410**, via the gas passageway **3156** and into the medicament cavity **3139**. The gas applies gas pressure to the piston member **3330** causing the piston member **3330** and the carrier **3370** to move in a distal direction within the medicament cavity **3139**, as shown by the arrow LL in FIG. **52**. When the carrier **3370** moves distally within the medicament cavity **3139**, the carrier **3370** and the medicament container **3200** are in a first configuration and collectively move toward a second position. In this manner, the medicament container **3200** and the needle **3216** contemporaneously move with piston member **3330** and/or the carrier **3370** in a distal direction. The movement of the needle **3216** in a distal direction causes the distal end portion of the needle **3216** to exit the housing **3100** and enter the body of a patient prior to administering the medicament **3220**.

As described above, at least a portion of the force exerted by the compressed gas within the gas chamber upon the piston member **3330** is transferred to the first shoulder **3377** of the carrier **3370** by the contact between the first surface **3341** of the piston member **3330** and the engagement portion **3379** of the carrier **3370**. This arrangement further allows at least a portion of the force to be transferred to the flange **3214** of the medicament container **3200**. In this manner, the application of the force on the piston member **3330** results in the distal movement of the carrier **3370** and the medicament container **3200**. Moreover, because the distal end portion **3332** of the piston member **3330** is configured such that the second surface **3342** is spaced apart from the elastomeric member **3217** within the medicament container **3200** (see e.g., FIG. **27**), the

force is not transferred to the elastomeric member **3217**. In this manner, the elastomeric member **3217** is isolated from the piston member **3330** when the medicament container **3200** is moving distally within the housing **3100**, which reduces and/or eliminates injection or leakage of the medicament **3220** from the medicament container **3200** during the needle insertion operation.

After the carrier **3370** and/or the needle **3216** have moved within the medicament cavity **3139** a predetermined distance, the carrier **3370** and the medicament container **3200** are moved from the first configuration to a second configuration. For example, in some embodiments, the retraction spring **3351** can be fully compressed and prevent the carrier **3370** from moving further in the distal direction. In other embodiments, a portion of the medicament container **3200** and/or a portion of the carrier **3370** can contact the housing **3100** when the needle insertion operation is completed, thereby limiting further distal movement of the carrier **3370**, medicament container **3200** and/or the needle **3216**. When the distal movement of the carrier **3370** is prevented, the gas within the gas chamber continues to apply gas pressure to the piston member **3330** causing the first surface **3341** of the piston member **3330** to deform a portion of the engagement portion **3379**. Similarly stated, when the distal movement of the carrier **3370** is complete, the force applied by the pressurized gas exceeds a threshold value, thereby causing the piston member **3330** to deform the engagement portion **3379**. In this manner, the engagement portion **3379** deforms (see e.g., FIG. **55**) to place the carrier **3370** in its second configuration, in which the first surface **3341** of the piston member **3330** is no longer in contact with the engagement portion **3379** and/or the first shoulder **3377**.

When the carrier **3370** is in the second configuration, the piston member **3330** continues to move in the distal direction relative to the carrier **3370** and/or the medicament container **3200**. Similarly stated, the piston member **3330** moves with the carrier **3370** during the insertion operation (i.e., when the carrier **3370** is in its first configuration) and the piston member **3330** moves relative to the carrier **3370** (and the medicament container **3200**) during the injection operation (i.e., when the carrier **3370** is in its second configuration). More particularly, after the engagement portion **3379** deforms, the piston rod **3333** of the piston member **3330** moves within the piston rod opening **3384** of the carrier **3370** and within the medicament container **3200**, as shown by the arrow MM in FIG. **53**. As the piston rod **3333** of the piston member **3330** moves within the carrier **3370** and medicament container **3200**, the second surface **3342** of the piston rod **3333** contacts the elastomeric member **3217** and generates a pressure upon the medicament **3220** contained within the medicament container **3200**, thereby allowing at least a portion of the medicament **3220** to flow out of the medicament container **3200** via the needle **3216**. The medicament **3220** is delivered to a body of a user via the medicament delivery path defined by the medicament container **3200** and the needle **3216**.

As shown in FIGS. **54** and **55**, after the piston member **3330** moves a predetermined distance within the medicament container **3200**, the gas valve actuator **3380** of the carrier **3370** engages the gas relief valve **3340** (see e.g., FIG. **55**) of the piston member **3330** thereby allowing the pressurized gas contained within the gas chamber (i.e., the volume within the medicament cavity **3139** between the proximal end of the housing **3100** and the proximal end of the piston member **3330**) to escape. Similarly stated, as the gas valve actuator **3380** of the carrier **3370** engages the gas relief valve **3340** of the piston member **3330**, the pressure within the housing **3100** is reduced, thereby ending the injection event. In this manner, the pre-injection distance between the proximal end portion **3331** of the piston member **3330** and the gas valve actuator **3380** of the carrier **3370** can be adjusted to control the amount of the medicament **3220** to be injected. After the gas pressure within the medicament cavity **3139** decreases below a certain level, the force exerted by the retraction spring **3351** on the engagement portion **3382** of the carrier **3370** is sufficient to cause the carrier **3370** to move proximally within the housing **3100** (i.e., to retract). Additionally, the second shoulder **3381** engages the distal surface of the flange **3214** of the medicament container **3200** to move the medicament container **3200** proximally within the housing **3100**, as shown by the arrow NN in FIG. **54**.

As described above, the protrusion **3520** of the base **3510** actuates the electronic circuit **3900** to trigger a predetermined output or sequence of outputs when the base **3510** is moved from its first position to its second position (see, e.g., FIGS. **35-39**). When the protrusion **3520** is moved in a proximal direction relative to the opening **3945**, as shown by the arrow HH in FIG. **39**, the electronic circuit system **3900** is actuated to output one or more predetermined electronic outputs. For example, in some embodiments, the electronic circuit system **3900** can output an electronic signal associated with recorded speech to the audible output device **3956**. Such an electronic signal can be, for example, associated with an audible countdown timer, instructing the user on the duration of the injection procedure. Said another way, if it takes, for example, ten seconds to complete an injection, an audible countdown timer can count from ten to zero ensuring that the user maintains the medical injector **3000** in place for the full ten seconds. In other embodiments, the electronic signal can be, for example, associated with a recorded message notifying the user that the injection is complete, instructing the user on post-injection disposal and safety procedures, instructing the user on post-injection medical treatment or the like. Such a status message can state, for example, "The injection is now complete. Please seek further medical attention from a doctor." The electronic circuit system **3900** can also simultaneously output an electronic signal to one and/or both LEDs **3958**A, **3958**B, thereby causing one and/or both LEDs **3958**A, **3958**B to stop flashing, change color or the like, to provide a visual indication that the injection is complete. In other embodiments, the electronic circuit system **3900** can send a wireless signal notifying a remote device that the injection is complete. In this manner, a patient's compliance and/or adherence with the use of the system can be monitored.

In some embodiments, the second actuation portion **3946** and the protrusion **3520** of the base **3510** can be configured such that the base **3510** and/or the actuator **3520** must move a predetermined distance before the protrusion **3520** engages the boundary **3949** of the opening **3945**. For example, in some embodiments, the protrusion **3520** must move approximately 0.200 inches before the actuator **3520** engages the boundary **3949** of the opening **3945**. In this manner, the base **3510** can be moved slightly without irreversibly moving the second switch **3973** of the electronic circuit system **3900** to the second state. Accordingly, this arrangement will permit the user to inadvertently and/or accidentally move the base **3510** without actuating the electronic circuit system **3900**.

While specific components are discussed with respect to the medical injector **3000**, in other embodiments, some components can be modified and/or removed without substantially changing the medicament injection event. For example, FIGS. **56-59** show a portion of a medical injector **4000**. That does not include an electronic circuit system (e.g., an electronic circuit system substantially similar to the electronic circuit system **3900** included in the medical injector **3000**). In

some embodiments, the electronic circuit system can be removed to limit the cost of the medical injector **4000**. In those embodiments devoid of an electronic circuit system, for example the medical injector **4000** shown in FIGS. **56** and **57**, the medical injector **4000** can still include components and/or portions configured to engage and/or interact with an electronic circuit system. For example, the medical injector **4000** includes a battery isolation protrusion **4197** of a cover **4190**. In this manner, the cost of production and tooling can be reduced by reducing the number of component variations. Additionally, an electronic circuit system (e.g., similar to the electronic circuit system **3900** included in the medical injector **3000**) can be easily added to the medical injector **4000** and disposed within an electronic circuit system cavity **4137** defined by the housing **4100**.

The medical injector **4000** is similar to the medical injector **3000** described above. As shown in FIGS. **56** and **57**, the medical injector **4000** includes a housing **4100**, the cover **4190** (FIG. **56**), a safety lock **4700** (FIG. **56**), a base **4510**, a system actuator assembly **4500**, a delivery mechanism **4300**, a medicament container **4200** and a needle guard assembly **4800**. The structure and operation of the cover **4190**, the safety lock **4700** and the base **4510** are similar to the structure and operation of the cover **3190**, the safety lock **3700** and the base **3510**, respectively. Accordingly, only the delivery mechanism **4300**, the system actuator assembly **4500** and the needle guard assembly **4800** are described in detail below.

As shown in FIG. **56**, the housing **4100** has a proximal end portion **4101** and a distal end portion **4102**. The housing **4100** defines a gas cavity **4151**, a medicament cavity **4139** and the electronic circuit system cavity **4137**. The gas cavity **4151**, medicament cavity **4139** and the electronic circuit system cavity **4137** of the housing **4100** of the medical injector **4000** are similar to the gas cavity **3151**, the medicament cavity **3139** and the electronic circuit system cavity **3137**, shown and described above with reference to FIGS. **15** and **16**.

The distal end portion **4102** of the housing **4100** is similar to the distal end portion **3102** of the housing **3100**, described above in reference to FIG. **15**. The proximal end portion **4101** includes a proximal cap **4103**. The proximal cap **4103** includes a gas container retention member **4580** and defines a gas passageway (not shown in FIGS. **56** and **57**). The gas container retention member **4580** is configured to receive a gas container **4410**. The gas container retention member **4580** extends from a distal surface of the proximal cap **4103** and is configured to place a proximal end **4411** of the gas container adjacent to the proximal cap **4103**. Similarly stated, the gas container retention member **4580** extends a given distance from the proximal cap **4103** such that the gas container **4410** is disposed adjacent to the proximal cap **4103** within a proximal end of the gas cavity **4151**. In this manner, the gas container retention member **4580** differs from the gas container retention member **3580**, which positions the gas container **3410** apart from the proximal cap **3103**.

The system actuator assembly **4500** includes the base **4510**, a release member **4550** and a spring **4576**. The release member **4550** has a proximal end portion **4551** and a distal end portion **4552**, and is movably disposed within the gas cavity **4151**. The proximal end portion **4551** and the distal end portion **4552** of the release member **4550** are similar to the corresponding structure of the release member **3550** of the medical injector **3000**, described above with reference to FIGS. **18-21**. The release member **4550** differs from the release member **3550**, however, in that the release member **4550** is substantially longer than the length of the release member **3550** of the medical injector **3000**. In this manner, the release member **4550** is able to engage the gas container **4410** disposed at the proximal end of the gas cavity **4151**. Similarly stated, with the gas container **4410** disposed at the proximal end of the gas cavity **4151**, the length of the release member **4550** is increased, compared to the release member **3550** of the medical injector **3000**, so that the release member **4550** can engage the gas container **4410**. Consequently, the length of the spring **4576** (in the compressed state) is longer than the length of the spring **3576** included in the medical injector **3000**, described above with reference to FIGS. **18-21**.

The arrangement of the system actuator assembly **4500**, the gas container **4410** and the gas container retention member **4580** function similar to the system actuator assembly **3500**, the gas container **3410** and the gas container retention member **3580**, respectively, to activate the delivery mechanism **4300**. In some embodiments, the gas container retention member **4580** can be configured to place the gas container **4410** at any suitable position within the gas cavity **4151**. In this manner, the length of the release member **4550** and the spring **4576** can be any given length such that the proximal end portion **4551** of the release member can engage the gas container **4410**, as shown in FIG. **57**.

The medicament delivery mechanism **4300** includes a carrier **4370** (also referred to herein as the "first movable member" **4370**) and a piston member **4330** (also referred to herein as the "second movable member" **4330**). The carrier **4370** is similar to the carrier **3370** included in the medical injector **3000** and is movably disposed within the medicament cavity **4139**. Therefore, the carrier **4370** is not described in detail herein.

The piston member **4330** includes a proximal end portion **4331**, a distal end portion **4332** and a piston rod **4333**. The piston portion **4330** is movably disposed within the medicament cavity **4139**. The proximal end portion **4331** includes a sealing member **4339** and is similar in form and function to the proximal end portion **3331** of piston member **3330** of the medical injector **3000** described above. The distal end portion **4332** includes a first surface **4341**, a second surface **4342** and an elongate protrusion **4343**. The second surface **4342** and the elongate protrusion **4343** are disposed within a portion of the carrier **4370** and within the medicament container **4200**. The first surface **4341** is configured to contact an engagement portion **4379** of the carrier **4370** when the medicament container **4200** is in a first configuration to maintain a given distance between the second surface **4342** and an elastomeric member **4217** of the medicament container **4200** (see e.g., FIG. **56**), in a similar manner as described above. The elongate protrusion **4343** is configured to be disposed within a channel **4218** defined by the elastomeric member **4217**. Similarly stated, the piston portion **4330** includes a portion and/or surface in contact with the elastomeric member **4217** and a portion and/or surface not in contact with the elastomeric member **4217**, when the carrier **4370** is in the first configuration. In some embodiments, the elongate protrusion **4343** can be used to align the piston rod **4333** with the elastomeric member **4217** disposed within the medicament container **4200**.

The piston member **4330** is configured to move within the housing **4100** (e.g., in response to the release of a pressurized gas). When the piston member **4330** moves, the first surface **4341** of the piston portion **4330** can apply a force to a portion of the carrier **4370** such that the carrier **4370** and the piston portion **4330** move together within the medicament cavity **4139**. As described above, after the carrier **4370** is placed in its second (or deformed) configuration, the piston rod **4333** can move relative to the carrier **4370** and the elongate **4343** and the second surface **4342** can engage the elastomeric

member **4217** to convey the medicament **4220** contained in the medicament container **4200** (see e.g., FIG. **57**).

As shown in FIGS. **58** and **59**, the medicament container **4200** is configured to be disposed within the carrier **4370**. The medicament container **4200** includes a proximal end portion **4212** and a distal end portion **4213**. The proximal end portion **4212** includes a flange **4214**. The distal end portion **4213** is in fluid communication with a needle **4216** (see e.g., FIG. **59**). The form and function of the medicament container **4200** is similar to the form and function of the medicament container **3200** of the medical injector **3000**. The medicament container **4200** also includes a damping member **4240** disposed at a distal surface of the flange **4214**.

The flange **4214** of the medicament container **4200** is disposed with in a flange groove **4385** defined by a first shoulder **4377** and a second shoulder **4381** of the carrier **4370**. The flange groove **4385** includes a portion configured to receive the damping member **4240**. In this manner, the damping member **4240** is configured to dampen a portion of a retraction force applied to the flange **4214** of the medicament container **4200** by the second shoulder **4381**. The arrangement of the damping member **4240** within the flange groove **4381** reduces the likelihood of the flange **4214** breaking under the force applied by the second shoulder **4381**, which can prevent the retraction of the medicament container **4200**.

The needle guard assembly **4800** includes an inner needle sheath **4810** and an outer needle sheath **4820**. The inner needle sheath **4810** includes an outer surface **4815** that has a ring **4816**. The inner needle sheath **4810** is disposed within the outer needle sheath **4820** (see e.g., FIGS. **58** and **59**). The inner needle sheath **4810** is similar to the needle sheath **3810** of the medical injector **3000**, described above with reference to FIG. **46**. Therefore, details of the inner needle sheath **4810** are not described in detail herein.

The outer needle sheath **4820** includes a proximal end portion **4821** and a distal end portion **4822**, and defines a lumen **4826** therebetween. The lumen **4826** is configured to receive the inner needle sheath **4810**. The proximal end portion **4821** includes an inner sheath aperture **4823** configured to receive the ring **4816** of the inner needle sheath **4810**. The ring **4816** extends from the outer surface **4815** of the inner needle sheath **4810** and a portion of the ring is disposed within the inner sheath aperture **4823**. The arrangement of the ring **4816** of the inner needle sheath **4810** and the inner sheath aperture **4823** prevent the movement of the inner needle sheath **4810** within the outer needle sheath **4810**.

The distal end portion **4822** includes a neck **4824** that has a rib **4825**. The neck **4824** of the distal end portion **4822** is configured to contact engagement members **4721** of the safety lock **4700**. Similarly stated, the neck **4824** of the distal end portion **4822** is disposed within a space defined between the engagement members **4721** of the safety lock **4700**. The engagement members **4721** allow the distal end portion **4822** of the outer needle sheath **4820** to move between the engagement members **4721** in a distal direction, but not in a proximal direction. Similarly stated, the engagement members **4721** include an edge that contacts the rib **4825** of the outer needle sheath **4820** such as to prevent the safety lock **4700** from moving in a distal direction relative to the outer needle sheath **4820**. Said another way, the needle guard assembly **4800** is removed from the needle **4216** when the safety lock **4700** is moved in a distal direction with respect to the housing **4100** (similar to the result as shown for the medical injector **3000** in FIG. **50**).

The function of the medical injector **4000** is substantially similar to the function of the medical injector **3000**, described with reference to FIGS. **9-55**. In this manner, the user of the medical injector **4000** can actuate the medical injector **4000** to inject a medicament, disposed within the medicament container **4200**, into an injection site of a patient.

Although the medicament injector **3000** and the medical injector **4000** are shown and described above as including a system actuation including the release of a pressurized gas, in other embodiments, a medicament delivery device can include any suitable method of delivery of a medicament disposed within. For example, FIGS. **60-98** show a medical injector **5000**, according to an embodiment that includes a mechanical energy storage member, rather than a compressed gas container. FIGS. **60-61** are perspective views of the medical injector **5000** in a first configuration (i.e., prior to use). The medical injector **5000** includes a housing **5100** (see e.g., FIGS. **62-70**), a system actuator **5500** (see e.g., FIGS. **71-73**), a medicament container **5200** containing a medicament **5220** (see e.g., FIG. **74**), a medicament delivery mechanism **5300**, a transfer member **5600** (see e.g., FIG. **75-80**), a cover **5190** (see e.g., FIGS. **81-82**), and a safety lock **5700** (see e.g., FIGS. **83-87**). A discussion of the components of the medical injector **5000** will be followed by a discussion of the operation of the medical injector **5000**.

As shown in FIGS. **62-70**, the housing **5100** includes a first housing member **5110** (FIGS. **66** and **67**) and a second housing member **5140** (FIGS. **68** and **69**) that can couple to form the housing **5100**. The housing **5100** has a proximal end portion **5101** and a distal end portion **5102**. The housing **5100** defines a first status indicator aperture **5130** (defined by the first housing member **5110**) and a second status indicator aperture **5160** (defined by the second housing member **5140**). The status indicator apertures **5130**, **5160** can allow a patient to monitor the status and/or contents of the medicament container **5200** contained within the housing **5100**. For example, by visually inspecting the status indicator aperture **5130** and/or **5160**, a patient can determine whether the medicament container **5200** contains a medicament **5220** and/or whether the medicament **5220** has been dispensed.

As shown in FIGS. **66-67**, the first housing member **5110** includes an outer surface **5113** and an inner surface **5116**, and a proximal end portion **5111** and a distal end portion **5112**. The outer surface **5113** includes cover retention protrusions **5104** at the proximal end portion **5111** of the first housing member **5110** (see e.g., FIGS. **61**, **62** and **66**). The cover retention protrusions **5104** are configured to be received within corresponding openings **5193** defined by the cover **5190** to retain the cover **5190** about the housing **5100**. In this manner, as described in more detail herein, the cover **5190** is removably coupled to and disposed about at least a portion of the housing **5100**.

The outer surface **5113** defines base retention recesses **5134**A and **5134**B, an activation rod groove **5115**, and base rail grooves **5114**, at the distal end portion **5112** of the first housing member **5110**. The distal base retention recesses **5134**A are configured to receive base connection knobs **5518** of an actuator **5510** (also referred to herein as "base **5510**," see e.g., FIG. **88**) when the base **5510** is in a first position relative to the housing **5100**. The proximal base retention recesses **5134**B are configured to receive the base connection knobs **5518** of the base **5510** when the base **5510** is in a second position relative to the housing **5100**. The base retention recesses **5134**A, **5134**B have a tapered proximal sidewall and a non-tapered distal sidewall. This allows the base retention recesses **5134**A, **5134**B to receive the base connection knobs **5518** such that the base **5510** can move proximally relative to the housing **5100**, but cannot move distally relative to the housing **5100**. Said another way, the distal base retention recesses **5134**A are configured to prevent the base **5510** from

moving distally when the base **5510** is in a first position and the proximal base retention recesses **5134**B are configured to prevent the base **5510** from moving distally when the base **5510** is in a second position. Similarly stated, the proximal base retention recesses **5134**B and the base connection knobs **5518** cooperatively to limit movement of the base **5510** to prevent undesirable movement of the base **5510** after the medical injector **5000** is actuated. The proximal base retention recesses **5134**B and the base connection knobs **5518** also provide a visual cue to the user that the medical injector **5000** has been used.

The activation rod groove **5115** is configured to receive an activator **5530** (also referred to herein as "release member **5530**," see e.g., FIG. **88**) of the base **5510**. As described in more detail herein, the release member **5530** of the base **5510** is configured to engage a portion of the medicament delivery mechanism **5300** when the base **5510** is moved with respect to the housing **5100**. The base rail grooves **5114** are configured to receive guide members **5517** of the base **5510**. The guide members **5517** of the base **5510** and the base rail grooves **5114** of the housing **5100** engage each other in a way that allows the guide members **5517** of the base **5510** to slide in a proximal and/or distal direction within the base rail grooves **5114** while limiting lateral movement of the guide members **5517**. This arrangement allows the base **5510** to move in a proximal and/or distal direction with respect to the housing **5100** but prevents the base **5510** from moving in a lateral direction with respect to the housing **5100**.

The inner surface **5116** of the first housing member **5110** includes a medicament container holder **5127**, an upper spring plate **5122** and an upper bias member plate **5123**. The inner surface **5166** also includes a series of protrusions that define a transfer member groove **5117**, piston portion grooves **5118** and a bias portion groove **5119** (see e.g., FIG. **67**). The medicament container holder **5127** is configured to receive a body **5210** of the medicament container **5200** (e.g., a prefilled syringe). The medicament container holder **5127** defines a latch member notch **5120** that includes an engagement surface **5109** (see e.g. FIG. **72**) configured to engage a latch protrusion **5315** of a latch portion **5310** of the medicament delivery mechanism **5300**. The medicament container holder **5127** includes a proximal end surface **5108**. The proximal end surface **5108** is configured to contact a portion of the medicament container **5200** (either directly or via intervening structure, such as an o-ring or damping member) when the medicament container **5200** is in a second position, as described in further detail herein.

The upper spring plate **5122** is disposed at the proximal end portion **5111** of the first housing member **5110**. The upper spring plate **5122** extends from the inner surface **5116** and is configured to contact a proximal end portion **5421** of a spring **5420** (see FIG. **91**). In this manner, when activated, the upper spring plate **5122** limits proximal movement of the spring **5420** such that the spring expands distally to move the medicament delivery mechanism **5300** in a distal direction (see e.g., FIG. **93**). Similarly stated, the upper spring plate **5122** receives a force from the spring **5420** and applies an equal and opposite reaction force to the proximal end portion **5421** of the spring **5420** such that a distal end portion **5422** of the spring **5420** expands in a distal direction, as described in further detail herein.

The upper bias plate **5123** is disposed at the proximal end portion **5111** of the first housing member **5110** and extends from the inner surface **5116**. The upper bias plate **5123** is configured to selectively engage a bias portion **5350** of the medicament delivery mechanism **5300** (see FIG. **91**). In this manner, the upper bias plate **5123** is configured to limit the proximal movement of the bias portion **5350** of the medicament delivery mechanism **5300**, as described in further detail herein.

As described above, the inner surface **5116** includes protrusions that define the transfer member groove **5117**, the piston portion grooves **5118** and the bias portion groove **5119**. The transfer member groove **5117** is configured to receive a guide protrusion **5619** of the transfer member **5600** (see FIG. **80**). The guide protrusion **5619** of the transfer member **5600** and the transfer member groove **5117** defined by the inner surface **5116** of the first housing member **5110** engage each other in a way that allows the guide protrusion **5619** of the transfer member **5600** to slide in a proximal and/or distal direction within the transfer member groove **5117** while limiting lateral movement of the guide protrusion **5619**. This arrangement allows the transfer member **5600** to move in a proximal and/or distal direction with respect to the housing **5100** but prevents the transfer member **5600** from moving in a lateral direction with respect to the housing **5100**. Similarly, the piston portion grooves **5118** are configured to receive the guide protrusions **5302** of the piston portion **5330** of the medicament delivery mechanism **5300** (see FIG. **76**). The bias portion groove **5119** is configured to receive the guide protrusion **5354** of the bias portion **5350** of the medicament delivery mechanism **5300** (see FIG. **76**). In this manner, the piston portion grooves **5118** and the bias member groove **5119** engage the guide protrusions **5302** of the piston portion **5330** and the guide protrusion **5354** of the bias portion **5350**, respectively, to prevent the medicament delivery mechanism **5300** from moving in a lateral direction with respect to the housing **5100** and/or rotating within the housing **5100**.

The inner surface **5116** of the first housing member **5110** further includes a transfer member release protrusion **5121**, a transfer member release support protrusion **5125**, a lower bias plate **5124**, and base lock protrusions **5126**. The transfer member release protrusion **5121** is configured to engage a latch arm **5618** of the transfer member **5600** to place the transfer member **5600** in a second configuration when the transfer member **5600** moves to a second position (see e.g., FIG. **97**). Contemporaneously, the transfer member release support protrusion **5125** supports the latch arm **5618** of the transfer member **5600** as the transfer member is placed in the second configuration, as described in further detail herein.

The lower bias plate **5124** engages a distal end portion **5353** of the bias portion **5350** of the delivery mechanism **5300** (see e.g., FIG. **95**), as described in further detail herein. The base lock protrusions **5126** are configured to engage base locks **5515** of the base **5510** when the safety lock **5700** is in contact with the medical injector **5000** (see FIG. **73**). Similarly stated, the safety lock **5700**, the base lock protrusions **5126**, and the base locks **5515** collectively prevent the base **5510** from moving in a proximal direction relative to the housing **5100** when the base locks **5515** of the base **5510** are in contact with the base lock protrusions **5126** of the first housing portion **5110**, as described in further detail herein.

The first housing member **5110** further includes a set of tabs **5128** and a set of openings **5129**. The tabs **5128** extend from portions of the inner surface **5116** of the first housing member **5110**. The first housing member **5110** can include any number of tabs **5128** that can have any suitable shape or size. For example, in some embodiments, the tabs **5128** vary in size. The tabs **5128** are configured to engage portions of the second housing member **5140** to couple the first housing member **5110** to the second housing member **5140**, as described in further detail herein.

As shown in FIGS. **68-70**, the second housing member **5140** includes an outer surface **5143** and an inner surface

5146. The second housing member 5140 also includes a proximal end portion 5141, a proximal cap 5103, and a distal end portion 5142. The outer surface 5143 defines base retention recesses 5134A and 5134B and base rail grooves 5114, at the distal end portion 5142 of the second housing member 5140. The distal base retention recesses 5134A are configured to receive base connection knobs 5518 of the base 5510 when the base 5510 is in a first position relative to the housing 5100. The proximal base retention recesses 5134B are configured to receive the base connection knobs 5518 of the base 5510 when the base 5510 is in a second position relative to the housing 5100. The base retention recesses 5134A, 5134B have a tapered proximal sidewall and a non-tapered distal sidewall. This allows the base retention recesses 5134A, 5134B to receive the base connection knobs 5518 such that the base 5510 can move proximally relative to the housing 5100, but cannot move distally relative to the housing 5100. Said another way, the distal base retention recesses 5134A are configured to prevent the base 5510 from moving distally when the base 5510 is in a first position and the proximal base retention recesses 5134B are configured to prevent the base 5510 from moving distally when the base 5510 is in a second position. Similarly stated, the proximal base retention recesses 5134B and the base connection knobs 5518 cooperatively limit movement of the base 5510 to prevent undesirable movement of the base 5510 after the medical injector 5000 is actuated. The proximal base retention recesses 5134B and the base connection knobs 5518 also provide a visual cue to the user that the medical injector 5000 has been used

The base rail grooves 5114 are configured to receive guide members 5517 of the base 5510. The guide members 5517 of the base 5510 and the base rail grooves 5114 of the second housing member 5140 engage each other in a way that allows the guide members 5517 of the base 5510 to slide in a proximal and/or distal direction within the base rail grooves 5114 while limiting lateral movement of the guide members 5517. This arrangement allows the base 5510 to move in a proximal and/or distal direction with respect to the housing 5100 but prevents the base 5510 from moving in a lateral direction with respect to the housing 5100.

The proximal cap 5103 extends from the proximal end portion 5141 of the second housing member 5140 and encloses the proximal end portion 5101 of the housing 5100 when the first housing member 5110 is coupled to the second housing member 5140.

The inner surface 5146 of the second housing member 5140 includes a medicament container holder 5157. The inner surface further includes protrusions that define a transfer member groove 5147, piston portion grooves 5148, and a bias portion groove 5149. The medicament container holder 5157 is configured to receive a body 5210 of the medicament container 5200 (e.g., a prefilled syringe). Moreover, the medicament container holder 5157 is configured to be coupled to a portion of the medicament container holder 5127 of the first housing member 5110 to define a space in which the medicament container 5200 is disposed. The medicament container holder 5157 includes a proximal end surface 5164. The proximal end surface 5164 is configured to contact a portion of the medicament container 5200 (either directly or via intervening structure) when the medicament container 5200 is in the second position, as described in further detail herein.

The transfer member groove 5147 receives a latch 5620 of the transfer member 5600 (see FIGS. 79 and 80). The latch 5620 of the transfer member 5600 and the transfer member groove 5147 defined by the inner surface 5146 of the second housing member 5140 engage each other in a way that allows the latch 5620 of the transfer member 5600 to slide in a proximal and/or distal direction within the transfer member groove 5147 while limiting lateral movement of the guide protrusion 5619. Similarly, the piston portion grooves 5148 are configured to receive the guide protrusions 5302 of the piston portion 5330 of the medicament delivery mechanism 5300. The bias portion groove 5149 is configured to receive the guide protrusion 5354 of the bias portion 5350 of the medicament delivery mechanism 5300. In this manner, the piston portion grooves 5148 and the bias member groove 5149 engage the guide protrusions 5302 of the piston portion 5330 and the guide protrusion 5354 of the bias portion 5350, respectively, to prevent the medicament delivery mechanism 5300 from moving in a lateral direction with respect to the housing 5100 and/or rotating within the housing 5100.

The second housing member 5140 further includes a set of tab latches 5163 and defines a set of openings 5159. The second housing member 5140 can include any number of tab latches 5163 such that the number of tab latches 5163 correspond to the number of tabs 5128 of the first housing member 5110. Collectively, the tabs 5128 of the first housing member 5110 and the tab latches 5163 of the second housing member 5140 couple the first housing member 5110 to the second housing member 5140. Similarly stated, the tabs 5128 are configured to engage the tab latches 5163 to define a lock fit. Moreover, a surface of the tabs 5128 is in contact with a surface of the tab latches 5163 to define a lock fit such that the first housing member 5110 and the second housing member 5140 couple together to define the housing 5100. The openings 5129 of the first housing member 5110 and the openings 5159 of the second housing member 5140 allow access to the tabs 5128 of the first housing member 5110 and the tab latches 5163 of the second housing member 5140, respectively. In this manner, the first housing member 5110 can be decoupled from the second housing member 5140.

As shown in FIG. 65, when the first housing member 5110 and the second housing member 5140 are assembled, the distal end portion 5102 of the housing 5100 defines a needle aperture 5105, a transfer member access opening 5106 and base lock openings 5131. Similarly stated, the first housing member 5110 and the second housing member 5140 collectively define the needle aperture 5105, the transfer member access opening 5106 and the base lock openings 5131. The needle aperture 5105 is configured to allow the needle 5216 (see e.g., FIGS. 74, 92 and 93) to exit the housing 5100 when the medical injector 5000 is actuated, as described in further detail herein.

The transfer member access opening 5106 is configured to provide access to the transfer member 5600 when the transfer member 5600 is disposed within the housing 5100. For example, in some embodiments, the transfer member 5600 can be disengaged from the medicament delivery mechanism 5300 without moving the medicament delivery mechanism 5300 in the distal direction. In this manner, the medical injector 5000 can be disabled such that the medicament delivery mechanism 5300 cannot engage the medicament container 5200 to convey a medicament 5220. For example, in some embodiments, a user, manufacturer and/or operator can disengage the transfer member 5600 from the medicament delivery mechanism 5300, via the transfer member access opening 5106, to safely dispose of an unused medical injector 5000 whose medicament 5220 expired. In other embodiments, an operator can manipulate the transfer member within the housing 5100 via the transfer member access opening 5106 during the assembly of the medical injector 5000.

The base lock openings 5131 are configured to receive the base locks 5515 and the safety lock protrusions 5702, as shown in the cross-sectional view of FIG. 73. The base lock

openings **5131** receive the base locks **5515** and the safety lock protrusions **5702** such that the base locks **5515** of the base **5510** are in contact with the base lock protrusions **5126** of the first housing member **5110** when the safety lock protrusions **5702** are disposed within the base lock openings **5131**. In this manner, the safety lock protrusions **5702** and the base lock protrusion **5126** prevent the base from moving in a proximal direction by placing the a proximal surface of the base locks **5515** in contact with a distal surface of the base lock protrusions **5126**. When the safety lock protrusions **5702** are removed from the base lock openings **5131**, the proximal surface of the tapered surface of the base locks **5515** allow movement in a proximal direction past the corresponding tapered surfaces of the base lock protrusions **5126** when the base **5510** is moved in the proximal direction.

FIGS. **71-80** show the medicament container **5200**, the system actuator **5500**, the transfer member **5600** and the medicament delivery mechanism **5300** of the medical injector **5000**. The medicament container **5200** has a body **5210** with a distal end portion **5213** and a proximal end portion **5212**. The body **5210** defines a volume **5211** that contains (i.e., is filled with or partially filled with) a medicament **5220** (see, e.g., FIG. **74**). The distal end portion **5213** of the medicament container **5200** includes a neck **5215** that is coupled to the needle **5216**, as described below. The proximal end portion **5212** of the medicament container **5200** includes an elastomeric member **5217** (i.e., a plunger) that seals the medicament **5220** within the body **5210**. The elastomeric member **5217** is configured to move within the body **5210** to inject the medicament **5220** from the medicament container **5200**. More particularly, as shown in FIG. **78**, the elastomeric member **5217** receives a piston rod **5333** of a piston portion **5330** included in the medicament delivery mechanism **5300**. The proximal end portion **5212** includes a flange **5214** and a damping member **5240** (see FIG. **78**) configured to engage the piston portion **5330** and the latch portion **5310** of the medicament delivery mechanism **5300**. The flange **5214** and the damping member **5240** are also configured to engage and/or contact the medicament container holders **5127** and **5157** of the housing **5100**.

The elastomeric member **5217** can be of any design or formulation suitable for contact with the medicament **5220**. For example, the elastomeric member **5217** can be formulated to minimize any reduction in the efficacy of the medicament **5220** that may result from contact (either direct or indirect) between the elastomeric member **5217** and the medicament **5220**. For example, in some embodiments, the elastomeric member **5217** can be formulated to minimize any leaching or out-gassing of compositions that may have an undesired effect on the medicament **5220**. In other embodiments, the elastomeric member **5217** can be formulated to maintain its chemical stability, flexibility and/or sealing properties when in contact (either direct or indirect) with the medicament **5220** over a long period of time (e.g., for up to six months, one year, two years, five years or longer). In some embodiments, the elastomeric member **5217** is similar to the elastomeric member **3217** of the medical injector **3000**, described with reference to FIG. **22**.

The medicament container **5200** can have any suitable size (e.g., length and/or diameter) and can contain any suitable volume of the medicament **5220**. Moreover, the medicament container **5200** and the piston portion **5330** can be collectively configured such that the piston portion **5330** travels a desired distance within the medicament container **5200** (i.e., the "stroke") during an injection event. In this manner, the medicament container **5200**, the volume of the medicament **5220** within the medicament container **5200** and the piston portion **5330** can be collectively configured to provide a desired fill volume and delivery volume. For example, the medicament container **5200**, as shown in FIG. **74**, is a pre-filled syringe and can be purchased and/or acquired with a given fill volume. In this manner, the piston portion **5330** can be configured to provide a desired delivery volume.

Moreover, the length of the medicament container **5200** and the length of the piston portion **5330** can be configured such that the medicament delivery mechanism **5300** can fit in the same housing **5100** regardless of the fill volume, the delivery volume and/or the ratio of the fill volume to the delivery volume. In this manner, the same housing and production tooling can be used to produce devices having various dosages of the medicament **5220**. For example, in a first embodiment (e.g., having a fill volume to delivery volume ratio of 0.4), the medicament container has a first length and the second movable member has a first length. In a second embodiment (e.g., having a fill volume to delivery volume ratio of 0.6), the medicament container has a second length shorter than the first length, and the second movable member has a second length longer than the first length. In this manner, the stroke of the device of the second embodiment is longer than that of the device of the first embodiment, thereby allowing a greater dosage. The medicament container of the device of the second embodiment, however, is shorter than the medicament container of the device of the first embodiment, thereby allowing the components of both embodiments to be disposed within the same housing and/or a housing having the same length.

As shown in FIGS. **71-74**, the system actuator **5500** includes the base **5510** and a release member **5530**, and is configured to move in the proximal and distal direction relative to the housing **5100**. Although the base **5510** and the release member **5530** are shown as being monolithically constructed to form the system actuator **5500**, in other embodiments the system actuator **5500** can include a base that is constructed separately from (and later joined to) a release member. As described above, when the medical injector **5000** is in its first configuration (i.e., the storage configuration), the base locks **5515** and the safety lock protrusions **5702** are disposed within the base lock opening **5131** such that the base locks **5515** are urged by the safety lock protrusions **5702** into contact with the base lock protrusions **5126**. Therefore, the system actuator **5500** and/or the base **5510** cannot move in the proximal direction to actuate the medicament delivery mechanism **5300**. Similarly stated, as shown in FIG. **73**, when the medical injector **5000** is in its first configuration (i.e., the storage configuration), the safety lock protrusions **5702** and the base lock protrusions **5126** cooperatively limit the proximal movement of the base **5510**.

The release member **5530** has a proximal end portion **5531** and a distal end portion **5532**. The release member **5530** extends from a proximal surface **5511** of the base **5510**. The proximal end portion **5531** of the release member **5530** is configured to engage that latch portion **5310** of the medicament delivery mechanism **5300** when the medical injector is in its first (or storage) configuration. More particularly, as shown in FIG. **72**, the proximal end portion **5531** of the release member **5530** maintains a first latch protrusion **5315** of the latch portion **5310** in contact with the engagement surface **5109** of the latch member notch **5120** of the housing **5100**. When the engagement surface **5109** is in contact with the first latch protrusion **5315**, the engagement surface **5109** applies a reaction force to the first latch protrusion **5315** in response to the force applied by the spring **5420**, which urges the transfer member **5600** and the medicament delivery mechanism **5300** in a distal direction. Similarly stated, when

the first latch protrusion **5315** is in contact with the engagement surface **5109**, the engagement surface **5109** limits distal movement of the first latch protrusion **5315**, and thus, the medicament delivery mechanism **5300**. In this manner, when the system actuator **5500** is in a first position (i.e., coupled to the distal end portion of the housing **5100**), the release member **5530** maintains the first latch protrusion **5315** within the latch member notch **5120** and maintains the medical injector **5000** in the first configuration (e.g., non-actuated configuration).

The medicament delivery mechanism **5300** (all or portions of which can also be referred to as a "first movable member") includes the latch portion **5310**, the piston portion **5330** and the bias portion **5350** (see e.g., FIGS. **75-78**). The latch portion **5310** is operably coupled to the spring **5420** via the transfer member **5600** (i.e., the second movable member **5600**). The medicament delivery mechanism **5300** includes a proximal end portion **5301**. The proximal end portion **5301** includes the guide protrusions **5302**, described above with reference to FIGS. **67-70**.

The latch portion **5310** includes a proximal end portion **5311** and a distal end portion **5312**. The proximal end portion **5311** is disposed at and/or joined with the proximal end portion **5301** of the medicament delivery mechanism **5300**. Similarly stated, the latch portion **5310** is configured to extend from the proximal end portion **5301** of the medicament delivery mechanism **5300** in the distal direction. The distal end portion **5312** of the latch portion **5310** includes a latch arm **5314** having a first latch protrusion **5315**, a second latch protrusion **5317**, and a second shoulder **5313**, and defines a channel **5316**. As described above, the first latch protrusion **5315** is configured to engage the release member **5530** and the engagement surface **5109** of the latch member notch **5120**. In particular, as shown in FIG. **72**, the release member **5530** urges, bends and/or deforms the latch arm **5314** to maintain the first latch protrusion **5315** within the latch member notch **5120**. Thus, the latch arm **5314** can be constructed from a flexible material such that the release member **5530** can urge, bend and/or deform the latch arm **5314** to engage the first latch protrusion **5315** with the latch member notch **5120**.

The channel **5316** of the latch portion **5310** is defined between a surface of the distal end portion **5312** of the latch portion **5310** and a proximal surface **5318** of the second latch protrusion **5317**. The channel **5316** is configured to receive the latch **5620** of the transfer member **5600**. More particularly, when the medical injector **5000** is in the first configuration, the proximal surface **5318** of the second latch protrusion **5317** is in contact with a distal surface **5621** of the latch **5620** of the transfer member **5600**. In this manner, the transfer member **5600** can transfer a force produced by the actuation of the spring **5420** to the latch portion **5310** of the medicament delivery mechanism **5300** to move the medicament delivery mechanism **5300** in the distal direction. Similarly stated, this arrangement allows the medicament delivery mechanism **5300** to move with and/or remain coupled to the transfer member **5600** (which can be referred to as a "second movable member") during the insertion and/or injection operation.

The piston portion **5330** includes a proximal end portion **5331** and a distal end portion **5332** and defines a piston rod **5333** therebetween. The proximal end portion **5331** is disposed at and/or joined with the proximal end portion **5301** of the medicament delivery mechanism **5300**. Similarly stated, the piston portion **5330** is configured to extend from the proximal end portion **5301** of the medicament delivery mechanism **5300** in the distal direction. The distal end portion **5332** is configured to be disposed at least partially within the proximal end portion **5212** of the medicament container **5200**. The piston rod **5333** defines recesses **5334**.

The piston portion **5330** includes two engagement members **5336** that have a first shoulder **5335** and a deformable portion **5338**. The engagement members **5336** are at least partially disposed within the recesses **5334** defined by the piston rod **5333**, and extend in a lateral direction relative to the piston portion **5330**. Similarly stated, the engagement members **5336** extend from the corresponding recess **5334** and are substantially perpendicular to a longitudinal axis defined by the piston portion **5330** between the proximal end portion **5331** and the distal end portion **5332**. In this manner, as described in more detail herein, when the engagement members **5336** are deformed (e.g., at the deformable portion **5338**), the engagement members **5336** fold into and/or are contained within the recesses **5334**. The engagement members **5336** can be any suitable size or shape. In some embodiments, the engagement members **5336** can be monolithically formed with the piston portion **5330**. In other embodiments, the engagement members **5336** can be formed separately from a brittle material and later coupled to the piston portion **5330**. In still other embodiments, the engagement members **5336** can be formed separately from a flexible material and coupled to the piston portion **5330**. In some embodiments, for example, the engagement members **5336** can be a single pin that is disposed through an opening within the piston portion **5330** such that the ends of the pins protrude from the recesses **5334**.

The first shoulder **5335** of the engagement member **5336** is disposed at a distal surface of the engagement member **5336**. As shown in FIG. **91**, the first shoulder **5335** is configured to engage a proximal surface of the flange **5214** of the medicament container **5200**. In this manner, the piston portion **5330** of the medicament delivery mechanism **5300** is configured to move the medicament container **5200** in response to a force applied by the spring **5420** when the medical injected **5000** is actuated. Similarly stated, when the release member **5530** actuates the medical injector **5000**, the transfer member **5600** transfers a force from the spring **5420** to the medicament delivery mechanism **5300** such that the first shoulder **5335** of the piston portion **5330** moves the medicament container **5200** from the first position to the second position.

The deformable portion **5338** of the engagement member **5336** is configured to deform during and/or to initiate an injection event. The deformable portion **5338** can be any suitable structure that deforms (e.g., either plastically or elastically, including bending, breaking, stretching or the like) when the force applied thereto exceeds a value. For example, in some embodiments, the deformable portion **5338** can include a fillet configured to act as a stress concentration riser configured to deform under a given force. In use within the medical injector **5000**, the deformable portion **5338** is configured to deform during and/or to initiate an injection event when the medicament container **5200** is in the second position. After deformation of the deformable portion **5338** and/or movement of the engagement members **5336**, the first shoulder **5335** is no longer in contact with the flange **5214** of the medicament container **5200** and the piston portion **5330** is allowed to move in a distal direction, relative to the medicament container **5200**.

The bias portion **5350** includes a proximal end portion **5352** and a distal end portion **5353**. The proximal end portion **5352** is disposed at and/or joined with the proximal end portion **5301** of the medicament delivery mechanism **5300**. Similarly stated, the bias portion **5350** is configured to extend from the proximal end portion **5301** of the medicament delivery mechanism **5300** in the distal direction.

The bias portion **5350** includes a serpentine portion **5355** constructed from any suitable material and having suitable dimensions such that the bias portion **5350** and/or the serpentine portion **5355** produce a force when the serpentine portion **5355** is compressed (see e.g., FIG. **95**). As described above, the bias portion **5350** includes guide protrusions **5354** (see e.g., FIG. **76**) configured to engage the bias member grooves **5119** defined by the first housing member **5110** and the bias member grooves **5149** defined by the second housing member **5140** to prevent the bias portion **5350** from moving in a lateral direction with respect to the housing **5100** and/or rotating within the housing **5100**. The distal end portion **5353** of the bias portion **5350** is configured to engage the lower bias plate **5124**. In this manner, a proximal surface of the lower bias plate **5124** prevents the distal end portion **5353** of the bias portion **5350** from moving in the distal direction as the medicament delivery device **5300** moves in the distal direction in response to the distal force applied by the spring **5420** when the medical injector **5000** is actuated. Therefore, the serpentine portion **5355** of the bias portion **5350** is compressed between the proximal end portion **5352** and the distal end portion **5353**.

The transfer member **5600** (also referred to as the "second movable member") includes a proximal end portion **5610** and a distal end portion **5611**, and is configured to move between a first configuration (see e.g., FIGS. **79** and **80**) and a second configuration (see e.g., FIGS. **97** and **98**). The proximal end portion **5610** is substantially cylindrical and is configured to engage and/or contact the spring **5420**. Moreover, the transfer member **5600** includes a ring protrusion **5612** that includes a proximal surface **5613** defining a spring seat **5615**. As shown in FIG. **72**, the distal end portion **5422** of the spring **5420** is disposed about the proximal end portion **5610** of the transfer member **5600**, and is configured to engage the spring seat **5615** defined by the ring protrusion **5612**.

The transfer member **5600** further includes a guide arm **5616** and the latch extension **5617** that extends from a distal surface **5614** of the ring protrusion **5612**. The guide arm **5616** is configured to guide the transfer member **5600** as it moves in the distal direction and provide support to the latch extension **5617** when the transfer member **5600** is placed in the second configuration, as described in further detail herein.

The latch extension **5617** includes the latch arm **5618** and a bendable portion **5622**. The latch arm **5618** includes the guide protrusion **5619** and the latch **5620**. As described above, the latch extension **5617** extends in a distal direction from the ring protrusion **5612** of the transfer member **5600**. The latch arm **5618** is configured to extend from the distal end portion **5611** of the transfer member **5610**. Similarly stated, the latch arm **5618** extends from a distal end portion of the latch extension **5617**. Moreover, the latch arm **5618** extends from the distal end portion of the latch extension **5617** at a suitable angle such that the latch **5620** is received within the channel **5316** (see e.g., FIG. **72**). For example, in some embodiments, the latch arm **5618** extends from the distal end portion of the latch extension **5617** at an acute angle. The guide protrusion **5619** is configured to engage the transfer member groove **5117**, as described above.

The latch **5620** extends from a proximal end portion **5623** of the latch arm **5618**. The latch **5620** is configured to engage the second latch protrusion **5317** of the latch portion **5310** of the medicament delivery mechanism **5300**. As described above, the distal surface **5621** of the latch **5620** is configured to be in contact with a proximal surface **5318** of the second latch protrusion **5317** when the transfer member **5600** is in the first configuration. In this manner, the transfer member **5600** transfers a force from the actuation of the spring **5420** to the medicament delivery mechanism **5300** via the transfer member **5600** to move the medicament delivery mechanism **5300** in the distal direction within the housing **5100**. Therefore, the force produced by the spring **5420** results in both the insertion of the needle **5216** and injection of the medicament **5220** within the medicament container **5200**, which occur as separate and distinct operations, as described herein.

Furthermore, when the transfer member **5600** has moved a desired distance in the distal direction, in response to the force produced by the actuation of the spring **5420**, the latch arm **5618** engages the transfer member release protrusion **5121** of the housing **5100** (see e.g., FIG. **67**) to place the transfer member **5600** in the second configuration. Similarly stated, the latch arm **5618** engages and/or contacts the transfer member release protrusion **5121** when the transfer member **5600** is in the second position. The bendable portion **5622** of the latch extension **5617** is configured to bend, relative to the latch extension **5617**. Thus, when the latch arm **5618** engages the transfer member release protrusion **5121**, the bendable portion **5622** of the transfer member **5600** bends, thereby placing the transfer member **5600** in its second configuration (see FIGS. **97** and **98**). When the transfer member **5600** is in its second configuration, the latch **5620** is disengaged from the second latch protrusion **5317** of the medicament delivery mechanism **5300**. Said another way, when the latch arm **5618** engages the transfer member release protrusion **5121**, the bendable portion **5622** of the transfer member bends such that the angle between the latch arm **5618** and the latch extension **5617** is reduced, thus disengaging the transfer member **5600** from the medicament delivery mechanism **5300**. Said yet another way, when the transfer member **5600** is in its second configuration, the medicament delivery mechanism **5300** is isolated and/or no longer operably coupled to the spring **5420**. In this manner, as described below, the retraction force exerted by the biasing portion **5350** moves the medicament delivery mechanism **5300** proximally within the housing **5100** to retract the needle **5216**.

FIGS. **81** and **82** show the cover **5190** of the medical injector **5000**. The cover **5190** includes a proximal end portion **5191** and a distal end portion **5192**, and defines a cavity **5196**. The cavity **5196** of the cover **5190** is configured to receive at least a portion of the housing **5100**. Thus, when the portion of the housing **5100** is disposed within the cover **5190**, the cover **5190** blocks an optical pathway between the medicament container **5200** and a region outside of the housing **5100**. Similarly stated, when the portion of the housing **5100** is disposed within the cover **5190**, the cover **5190** is obstructs the first status indicator aperture **5130** and/or the second status indicator aperture **5160** of the housing **5100** to reduce the amount of light transmitted to the medicament **5220** within the medicament container **5200**. In this manner, the life of the medicament **5220** can be extended by the prevention and/or reduction of degradation to the medicament **5220** that may be caused by ultra-violet radiation.

The proximal end portion **5191** of the cover **5190** defines apertures **5193**. The apertures **5193** configured to receive the cover retention protrusions **5104** of the housing **5100** (shown in FIGS. **10** and **12**). In this manner, the apertures **5193** and the cover retention protrusions **5104** of the housing **5100** removably retain the cover **5190** about at least a portion of the housing **5100**. Said another way, the apertures **5193** and the cover retention protrusions **5104** of the housing **5100** are configured such that the cover **5190** can be removed from a portion of the housing **5100** and then replaced about the portion of the housing **5100**.

The cover **5190** can be any suitable configuration and can include any suitable feature. For example, the cover **5190**

includes openings **5195** and notches **5194**. In some embodiments, the openings **5195** can receive inserts (not shown). The inserts can be a flexible inserts and can be configured to increase friction between the cover **5190** and a surface. For example, the inserts can increase the friction between the cover **5190** and a surface on which the medical injector **5000** is placed, to prevent sliding. The notches **5194** are disposed at the proximal end of the cover **5190**. In some embodiments, the notches **5194** can be used to reduce the material needed to manufacture the cover **5190**.

FIGS. **83-87** show the safety lock **5700** of the medical injector **5000**. The safety lock **5700** of the medical injector **5000** includes a proximal surface **5730**, a distal surface **5740** opposite the proximal surface **5730** and a needle sheath **5810**. The safety lock **5700** defines a needle sheath aperture **5703**. The proximal surface **5730** of the safety lock **5700** includes two safety lock protrusions **5702**, two opposing pull-tabs **5710** and an engagement portion **5720**. As described above, when the safety lock **5700** is in a first (locked) position, the safety lock protrusions **5702** are configured to be disposed through the safety lock protrusion apertures **5514** defined by the base **5510** (see e.g., FIG. **88**) and within the base lock openings **5131** defined by the distal end portion **5102** of the housing **5100** (see e.g., FIG. **73**). Accordingly, the safety lock protrusions **5702** are configured to prevent the base locks **5515** of the base **5510** from moving past the base lock protrusion **5126** of the first housing member **5110**, thereby preventing proximal movement of the base **5510** and/or delivery of the medicament **5220**. Similarly stated, when the medical injector **5000** is in its first configuration (i.e., the storage configuration), the safety lock protrusions **5702** are disposed adjacent and/or in contact with the base lock protrusions **5126**, thereby preventing lateral deformation (e.g., a outward flexing motion) of the base lock protrusions **5126**. Thus, the arrangement of the safety lock protrusions **5702** prevents the system actuator **5500** and/or the base **5510** from moving in the proximal direction to actuate the medicament delivery mechanism **5300**.

The pull-tabs **5710** of the safety lock **5700** include a grip portion **5712**. The grip portion **5712** of the pull-tabs **5710** provides an area for the user to grip and/or remove the safety lock **5700** from the rest of the medicament delivery system **5700**. In some embodiments, the pull-tabs **5710** can include indicia, such as, for example, an indicia similar to that included in the pull tabs **3710** of the safety lock **3700**, described with reference to FIG. **43**.

The engagement portion **5720** of the safety lock **5700** includes engagement members **5721**. The engagement members **5721** extend in a proximal direction from the proximal surface **5730**. The engagement members **5721** have tabs **5722** that extend from a surface of the engagement members **5721**. The tabs **5722** are configured to engage an outer surface **5815** of a distal end portion **5812** of the needle sheath **5810**.

As shown in FIGS. **86** and **87**, the needle sheath **5810** includes the distal end portion **5812**, a proximal end portion **5811** and a rib **5816**. The needle sheath **5810** further includes a contoured portion **5814** that defines a bore **5813**. The bore **5813** of the needle sheath **5810** is configured to receive the needle **5216** and/or a distal end portion of the **5213** of the medicament container **5200**. The contoured portion **5814** of the needle sheath **5810** defines a friction fit with the distal end portion **5213** of the medicament container **5200**. In this manner, the needle sheath **5810** can protect the user from the needle **5216** and/or can keep the needle **5216** sterile before the user actuates the medical injector **5000**. The proximal end portion **5811** of the needle sheath is configured to contact the body **5210** of the medicament container **5200**.

The distal end portion **5812** of the needle sheath **5810** is configured to be inserted into a space defined between the tabs **5722** of the engagement members **5721** of the safety lock **5700**. The tabs **5722** are angled and/or bent towards the distal direction to allow the distal end portion **5812** of the needle sheath **5810** to move between the engagement members **5721** in a distal direction, but not in a proximal direction. Similarly stated, the tabs **5722** include an edge that contacts the outer surface **5815** of the needle sheath **5810** to prevent the safety lock **5700** from moving in a distal direction relative to the needle sheath **5810**. Said another way, the needle sheath **5810** is removed from the needle **5216** when the safety lock **5700** is moved in a distal direction with respect to the housing **5100** (see e.g., FIG. **90**).

FIGS. **88** and **89** show the base **5510** (or actuator) of the medical injector **5000**. The base **5510** includes the proximal surface **5511**, a distal surface **5523** and base connection knobs **5518**. The base **5510** defines a needle aperture **5513**, safety lock protrusion apertures **5514**, transfer member access opening **5516** and pull-tab openings **5519**. The needle aperture **5513** is configured to receive the needle **5216** when the medical injector **5000** is actuated. The safety lock protrusion apertures **5514** of the base **5510** receive the safety lock protrusions **5702** of the safety lock **5700** when the medical injector **5000** is in the first configuration, as described above. The transfer member access opening **5516** provides access to the transfer member **5600** when the transfer member **5600** is disposed within the housing **5100**. The pull-tab openings **5519** are configured to receive the pull-tabs **5710** of the safety lock **5700** when the medical injector **5000** is in the first configuration.

The proximal surface **5511** of the base **5510** includes and/or is coupled to the release member **5530**, guide members **5517** and base locks **5515**. The release member **5530** includes a proximal end portion **5531** and a distal end portion **5532** and defines a channel **5533** between a system lock surface **5534** and the distal end portion **5532** (see e.g., FIG. **89**). As shown in FIG. **71**, the system lock surface **5534** is disposed at the proximal end portion **5531** and is configured to engage the first latch protrusion **5315** of the medicament delivery mechanism **5300**. Moreover, the system lock surface **5534** engages the first latch protrusion **5315** such that the system lock surface **5534** maintains the engagement of the first latch protrusion **5315** and the latch member notch **5120**, as described above and shown in FIG. **72**. Similarly stated, the system lock surface **5534** of the release member **5530** applies a force to the first latch protrusion **5315** to maintain the first latch protrusion **5315** within the latch member notch **5120**. When the system actuator **5500** is moved in a proximal direction, as described in further detail herein, the system lock surface **5534** moves in the proximal direction to disengage the first latch protrusion **5315**. In response, the first latch protrusion **5315** moves within the channel **5533** of the release member **5530** in a distal direction, as described in further detail herein. Similarly stated, upon actuation of the medicament injector **5000**, a portion of the medicament delivery mechanism **5300** moves within the release member **5530**.

The guide members **5517** of the base **5510** are configured to engage and/or slide within the base rail grooves **5114** of the housing **5100**, as described above. The base locks **5515** of the base **5510** are configured to engage the base lock protrusions **5126** of the first housing member **5110**. As described in further detail herein, when the safety lock **5700** is removed and the base **5510** is moved in a proximal direction with respect to the housing **5100**, the base locks **5515** of the base **5510** are configured to disengage from the base lock protrusions **5126** and move in the proximal direction, relative to the

base lock protrusions **5126**. As described above, the base connection knobs **5518** are configured to engage the base retention recesses **5134**A, **5134**B in a way that allows proximal movement of the base **5510** but limits distal movement of the base **5510**.

The medical injector **5000** is first enabled by moving the medicament delivery device **5000** from a first configuration to a second configuration by moving the cover **5190** from a first position to a second position. The cover **5190** is moved from the first position to the second position by moving it with respect to the housing **5100** in the distal direction. For example, the cover **5190** can be moved similarly to the cover **3190** of the medical injector **3000** described with reference to FIG. **49**.

After the cover **5190** is removed from the housing **5100**, the medical injector **5000** can be moved from the second configuration to a third configuration by moving the safety lock **5700** from a first position to a second position. The safety lock **5700** is moved from a first position to a second position by moving the safety lock **5700** with respect to the housing **5100** in the direction shown by the arrow OO in FIG. **90**. Similarly stated, the medical injector **5000** can be moved from the second configuration to a third configuration by removing the safety lock **5700** from the distal end portion **5102** of the housing **5100**. When the safety lock **5700** is moved from the first position to the second position, the safety lock protrusions **5702** are removed from within the base lock openings **5131** of the first housing member **5110**, thereby enabling the system actuator **5500** and/or the base **5510**. Similarly stated, when the safety lock **5700** is in the second position, the safety lock protrusions **5702** no longer maintain the engagement of the base locks **5515** with the base lock protrusions **5126** and/or the base locks **5515** can slide proximally relative to the base lock protrusion **5126** of the housing **5100**. In this manner, the base **5510** can be moved from a first position to a second position. Moreover, with the safety lock **5700** removed, the needle sheath **5810** is removed from the medicament container **5200**, as shown in FIG. **91**.

After the safety lock **5700** is moved from the first position to the second position, the medical injector **5000** can be moved from the third configuration to a fourth configuration (i.e., the needle insertion configuration) by moving the base **5510** from the first position to the second position. Similarly stated, the medical injector **5000** can be actuated by the system actuator **5500** by moving the base **5510** proximally relative to the housing **5100**. The base **5510** is moved from its first position to its second position by placing the medical injector **5000** against the body of the patient and moving the base **5510** with respect to the housing **5100** in the direction shown by the arrow PP in FIG. **92**. With the base locks **5515** disengaged from the base lock protrusions **5126**, the system actuator **5500** can move in the proximal direction causing the base locks **5515** move proximally past the base lock protrusions **5126**.

When the base **5510** is moved from the first position to the second position, the system actuator **5500** actuates the medicament delivery mechanism **5300**, thereby placing the medical injector **5000** in its fourth configuration (i.e., the needle insertion configuration), as shown in FIGS. **92-94**. More specifically, the proximal movement of the system actuator **5500** and/or the base **5510** moves the release member **5530** in the proximal direction within the housing **5100**, thereby allowing the first latch protrusion **5315** to be disengaged from the system lock surface **5534** of the proximal end portion **5533** of the release member **5530**. Similarly stated, when the system actuator **5500** is moved in the proximal direction, the system lock surface **5534** disengages the first latch protrusion **5315**. Moreover, when the system lock surface **5534** moves in the proximal direction relative to the first latch protrusion **5315**, the first latch protrusion **5315** moves into the channel **5533** defined by the release member **5530**.

When the first latch protrusion **5315** is disposed within the channel **5533**, the force applied by the system lock surface **5534** of the base **5510** to maintain the first latch protrusion **5315** within the latch member notch **5120** is removed and the first latch protrusion **5315** is allowed to disengage the latch member notch **5120**. Therefore, the engagement surface **5109** of the latch member notch **5120** no longer applies the reaction force to the first latch protrusion **5315**; thus, the spring **5420** is allowed to expand. As described above, the proximal end portion **5421** of the spring **5420** is in contact with the upper spring plate **5122** of the first housing member **5110** such that the spring **5420** expands in the direction shown be the arrow QQ in FIG. **93**. With the distal end portion **5422** of the spring **5420** in contact with the spring seat **5615** of the transfer member **5600**, a force F_4 produced by the expansion of the spring **5420** is applied to the transfer member **5600**, which moves the transfer member **5600** in the direction shown by the arrow QQ. In this manner, the latch **5620** of the transfer member **5600** transfers at least a portion of the force F_4 to the second latch protrusion **5317** of the latch portion **5310** of the medicament delivery mechanism **5300** such that the portion of the force moves the medicament delivery mechanism **5300** in the distal direction, shown by the arrow QQ in FIG. **93**. Thus, the medicament delivery mechanism **5300** (the first movable member) and the transfer member **5600** (the second movable member) move together distally within the housing.

When the medicament delivery mechanism **5300** is moving distally, the piston portion **5330** of the medicament delivery mechanism **5300** applies a portion of the force F_4 to the medicament container **5200**. More specifically, as shown in FIG. **94**, the first shoulder **5335** of each engagement member **5336** contacts the flange **5214** of the medicament container **5200**. The movement of the medicament delivery mechanism **5300** moves the piston portion **5330** in the distal direction. Therefore, with the first shoulder **5335** of each engagement member **5336** in contact with the flange **5214** of the medicament container **5200**, the first shoulder **5335** transfers a portion of the force F_4 to the medicament container **5200** to move the medicament container **5200** in the distal direction. The movement of the medicament container **5200** within the housing **5100** results in the needle insertion operation.

As shown in FIG. **78**, the distance between the end surface of the piston rod **5333** and the engagement members **5336** is such that when the first shoulder **5335** of each engagement member **5336** contacts the flange **5214**, the distal end portion **5332** of the piston rod **5333** is spaced apart from the elastomeric member **5217** within the medicament container **5200**. This arrangement prevents any portion of the force F_4 from being applied or transferred to the plunger **5217**. Said another way, during the needle insertion operation (i.e., when the medical injector is being moved to its fourth configuration) the plunger **5217** is isolated from the piston portion **5330**. Accordingly, this arrangement reduces and/or eliminates leakage and/or injection of medicament **5220** from the medicament container **5200** during the needle insertion operation.

After the transfer member **5600**, the medicament delivery mechanism **5300** and the medicament container **5200** move in the distal direction a given distance, the damping member **5240** of the medicament container **5200** contacts the proximal surface **5108** of the medicament container holder **5127** and **5157** of the first housing portion **5110** and the second housing portion **5140**, respectively. The proximal surface **5108** prevents the medicament container **5200** from moving further in the distal direction. Thus, when the flange **5214** and/or the

damping member **5240** contact the proximal surface **5108**, the needle **5216** is fully inserted into the target location of a patient. At this point, the medical injector **5000** can be moved from the fourth configuration to the fifth configuration (i.e., the medicament delivery configuration), shown in FIGS. **95** and **96**.

When the damping member **5240** of the medicament container **5200** is in contact with the proximal surface **5108** of the medicament container holders **5127** and **5157**, the medicament container **5200** is prevented from moving in the distal direction. The portion of the force F_4 applied by the spring **5420**, however, continues to urge the transfer member **5600** and the medicament delivery mechanism **5300** in the direction shown by the arrow RR in FIG. **95**. More specifically, when the medicament container **5200** is in contact with the medicament container holders **5127** and **5157**, the force F_4 applied by the spring **5420** moves the transfer member **5600** and the medicament delivery mechanism **5300** in the distal direction, relative to the medicament container **5200**. In this manner, the portion of the force F_4 applied to the medicament delivery mechanism **5300** causes the deformable portion **5338** of the engagement members **5336** to deform and/or bend inward (see e.g., FIG. **96**). Similarly stated, the deformable portion **5338** of each of the engagement members **5336** is configured to deform when the damping member **5240** of the medicament container **5200** is in contact with the proximal surface **5108** of the medicament container holders **5127** and **5157**. When the deformable portion **5338** is deformed, the engagement members **5336** are disposed within the recesses **5334** defined by the piston rod **5333** (see e.g., FIG. **96**). In this manner, the piston rod **5333** is configured to move within the medicament container **5200** into contact with the elastomeric member **5217** to deliver the medicament **5220**. Similarly stated, the piston portion **5330** is moved from its first configuration, in which the engagement members **5336** collectively have a size that is greater than the size (i.e., diameter) of the inner bore of the medicament container **5200** to its second configuration, in which the engagement members **5336** collectively have a size that is less than the size (i.e., diameter) of the inner bore of the medicament container **5200**. This decrease in size (or diameter) allows the piston rod **5333** to move within the medicament container **5200**.

When the medicament delivery mechanism **5300** moves in the distal direction to move the elastomeric member **5217** and inject the medicament **5220**, the serpentine portion **5355** and/or the bias portion **5350** is also compressed. More specifically, a portion of the force F_4 compresses the serpentine portion **5355** and/or the bias portion **5350** between the proximal end portion **5301** of the medicament delivery mechanism **5300** and the lower bias plate **5124**. Similarly stated, the bias portion **5350** is configured to compress as the serpentine portion **5355** elastically deforms (e.g., bending, squeezing, or compressing such that the bias portion **5350** returns to a non-deformed configuration when the deforming force is removed). In this manner, the space defined between adjacent portions of the serpentine portion **5355** is reduced.

As the spring **5420** fully expands, the medicament delivery mechanism **5300** moves in the distal direction to fully inject the medicament **5220** within the medicament container **5200** through the needle **5216**. Additionally, when the spring **5420** is fully expanded and/or when the medicament delivery mechanism **5300** has moved a desired distance within the housing **5100**, the latch arm **5618** of the transfer member **5600** engages the transfer member release protrusion **5121** of the housing **5100**. As described above, the transfer member release protrusion **5121** contacts the latch arm **5618** of the transfer member **5600** such that the bendable portion **5622** disposed at the distal end of the latch extension **5617** bends. In this manner, the latch **5620** of the latch arm **5618** is disengaged from the second latch protrusion **5318** of the latch portion **5310** of the medicament delivery mechanism **5300** (see e.g., FIGS. **97** and **98**). Similarly stated, the spring **5240** and/or the transfer member **5600** are decoupled from the medicament delivery mechanism **5300**. With the latch arm **5618** disengaged from the latch portion **5310**, the medical injector **5000** can be moved from the fifth configuration to the sixth configuration (i.e., the retraction configuration).

As shown in FIG. **98**, the transfer mechanism **5600** is deformed such that the transfer member **5600** and/or the spring **5420** are no longer engaged with the medicament delivery mechanism **5300**. Therefore, the medicament delivery mechanism **5300** is configured to move within the housing **5100** in the direction shown by the arrow SS in FIG. **97** in response to the force produced by the bias portion **5350**. Similarly stated, with the medicament delivery mechanism **5300** disengaged from the transfer member **5600** and/or the spring **5420**, the force F_4 is no longer applied to the medicament delivery mechanism **5300**. In this manner, the bias portion **5350** is configured to expand in the direction of the arrow SS shown in FIG. **97** to apply a retraction force to the medicament delivery mechanism **5300**. Similarly stated, with the portion of the force F_4 configured to compress the bias portion **5350** removed, the bias portion **5350** expands, returning to its uncompressed (i.e., non-deformed) configuration.

During the retraction operation, the second shoulder **5313** included in the latch portion **5310** is configured to engage a distal surface of the damping member **5240** and/or the flange **5214**. The second shoulder **5313** is further configured to transmit the retraction force produced by the expansion of the bias portion **5350** to the flange **5214**, thereby moving the medicament container **5200** proximally. Similarly stated, the medicament container **5200** is moved in the proximal direction towards the first position of the medicament container **5200**. This motion, removes the needle **5216** from the target location of the patient and retracts the needle into the housing **5100**, as shown in FIG. **97**.

While various embodiments of the invention have been described above, it should be understood that they have been presented by way of example only, and not limitation. Where methods described above indicate certain events occurring in certain order, the ordering of certain events may be modified. Additionally, certain of the events may be performed concurrently in a parallel process when possible, as well as performed sequentially as described above.

Although the first surface **3341** of the piston member **3330** is shown as being substantially parallel to the second surface **3342** of the piston member **3330**, in other embodiments, the first surface of a movable member can be at any suitable angular orientation to a second surface of the movable member.

Although the carrier **3370** is shown as substantially surrounding the medicament container **3200**, in other embodiments, a carrier and/or the contact shoulders (analogous to the first shoulder **3377** and the second shoulder **3381**) need not substantially surround the medicament container **3200**. For example, in some embodiments, a carrier can be a single piece member that only partially surrounds the flange **3214** of the medicament container **3200**. Similarly stated, in some embodiments, a carrier need not be movable between an opened configuration and a closed configuration, but rather can receive and/or retain the medicament container in a single configuration.

Although the carrier **4370** is described above as being configured to accommodate an o-ring or other suitable damp-

ing member to reduce the forces exerted on the medicament container **4200** during insertion and/or injection, in other embodiments, any suitable mechanisms or structures for reducing the energy, impulse and/or forces applied to the carrier, the medicament container, the housing and/or the actuation member can be employed. For example, in some embodiments, a carrier can include a deformable portion (e.g., a "crush rib") configured to deform when contacting the housing during an insertion event. In this manner, the deformable portion can absorb at least a portion of the energy and/or force generated during the impact, thereby reducing the magnitude of the energy, impulse and/or force applied to the medicament container. Similarly, in some embodiments, a portion of a medicament delivery mechanism, such as medicament delivery mechanism **4300** can include a crush rib or an impact portion configured to plastically and/or elastically deform to absorb and/or dampen the forces from the needle insertion operation.

In some embodiments, the outer surface **3815** of the needle sheath **3810** can include a cap or cover that has different material properties than the remainder of the needle sheath **3810**. For example, in some embodiments, the outer surface **3815** can be constructed of a material having greater hardness and/or rigidity than the remainder of the needle sheath **3810**. This arrangement allows for sufficient structural rigidity to assembly the needle sheath **3810** within the engagement portion **3720** of the safety lock **3700**. In other embodiments, however, any of the needle sheaths described herein need not include an outer cover or cap. The use of a cap-less design can reduce manufacturing and/or assembly costs.

Although the medical injector **3000** is shown above as including a gas container **3410** that is actuated by a puncturer that moves within the housing **3100** with the release member **3550**, in other embodiments a system actuation assembly **3500** can include a puncturer that is substantially fixed within the housing and a gas container that moves within the housing into contact with the puncturer upon actuation of the device.

Although the medicament delivery mechanism **5300** is shown above as being a monolithically constructed member (i.e., a "first movable member"), in other embodiments, the medicament delivery mechanism **5300** can include multiple members that are separately constructed and/or that are coupled together. For example, in some embodiments, a medicament delivery mechanism can include a first member that corresponds to the latch portion **5310** and the piston portion **5330**, and a second, separately constructed member that produces a refraction force (e.g., similar to the function of the bias portion **5350**. In such embodiments, for example, second member can be a separately constructed coil spring or the like.

Any of the devices and/or medicament containers shown and described herein can be constructed from any suitable material. Such materials include glass, plastic (including thermoplastics such as cyclic olefin copolymers), or any other material used in the manufacture of prefilled syringes containing medications.

Any of the devices and/or medicament containers shown and described herein can include any suitable medicament or therapeutic agent. In some embodiments, the medicament contained within any of the medicament containers shown herein can be a vaccine, such as, for example, an influenza A vaccine, an influenza B vaccine, an influenza A (H1N1) vaccine, a hepatitis A vaccine, a hepatitis B vaccine, a haemophilus influenza Type B (HiB) vaccine, a measles vaccine, a mumps vaccine, a rubella vaccine, a polio vaccine, a human papilloma virus (HPV) vaccine, a tetanus vaccine, a diphtheria vaccine, a pertussis vaccine, a bubonic plague vaccine, a yellow fever vaccine, a cholera vaccine, a malaria vaccine, a smallpox vaccine, a pneumococcal vaccine, a rotavirus vaccine, a varicella vaccine, a rabies vaccine and/or a meningococcus vaccine. In other embodiments, the medicament contained within any of the medicament containers shown herein can be a catecholamine, such as epinephrine. In other embodiments, the medicament contained within any of the medicament containers shown herein can be an opioid receptor antagonist, such as naloxone, including any of the naloxone formulations described in U.S. patent application Ser. No. 13/036,720, entitled "Medicament Delivery Device for Administration of Opioid Antagonists Including Formulation for Naloxone," filed on Feb. 28, 2011. In yet other embodiments, the medicament contained within any of the medicament containers shown herein can include peptide hormones such as insulin and glucagon, human growth hormone (HGH), erythropoiesis-stimulating agents (ESA) such as darbepoetin alfa, monoclonal antibodies such as denosumab and adalimumab, interferons, etanercept, pegfilgrastim, and other chronic therapies, or the like. In yet other embodiments, the medicament contained within any of the medicament containers shown herein can be a placebo substance (i.e., a substance with no active ingredients), such as water.

Although the medical injector **3000** includes the electronic circuit system cavity **3153**, the gas cavity **3154** and/or the medicament cavity **3157** that are shown and described as being fluidically and/or physically isolated from each other, in other embodiments, any of the electronic circuit system cavity **3153**, the gas cavity **3154** and/or the medicament cavity **3157** can be fluidically coupled to and/or share a common boundary with each other. In some embodiments, for example, a housing can define a single cavity within which a medicament container, an energy storage member and an electronic circuit system are disposed.

The medicament containers and/or medicament delivery devices disclosed herein can contain any suitable amount of any medicament. For example, in some embodiments, a medicament delivery device as shown herein can be a single-dose device containing an amount medicament to be delivered of approximately 0.4 mg, 0.8 mg, 1 mg, 1.6 mg or 2 mg. As described above, the fill volume can be such that the ratio of the delivery volume to the fill volume is any suitable value (e.g., 0.4, 0.6 or the like). In some embodiments, an electronic circuit system can include "configuration switch" (similar to the configuration switch **3974** shown and described above) that, when actuated during the assembly of the delivery device, can select an electronic output corresponding to the dose contained within the medicament container.

Although the electronic circuit system **3900** is shown and described above as having two irreversible switches (e.g., switch **3972** and switch **3973**), in other embodiments, an electronic circuit system can have any number of switches. Such switches can be either reversible or irreversible.

Although the electronic circuit system **3900** is shown and described above as producing an electronic output in response to the actuation of two switches (e.g., switch **3972** and switch **3973**), in other embodiments, an electronic circuit system can produce an electronic output in response to any suitable input, command or prompt. Suitable input for prompting an output can include, for example, an audible input by the user (e.g., the user's response to a voice prompt produced by the electronic circuit system), an input from a "start button" depressed by the user, an input from a sensor (e.g., a proximity sensor, a temperature sensor or the like), movement of (e.g., shaking) of the medicament delivery device, or the like.

In some embodiments, an electronic circuit system can include a microphone and/or a voice recognition module to detect a user's vocal input.

Although medical devices having two LEDs and an audio output device have been shown, in other embodiments the medical device might have any number of LEDs and/or audio output devices. Additionally, other types of output devices, such as haptic output devices, can be used. In some embodiments, outputs from an electronic circuit system can include, for example, an audible or visual output related to the composition of the medicament (e.g., an indication of the expiration date, the symptoms requiring treatment with the medicament or the like), the use of the medicament delivery device, and/or post-administration procedures (e.g., a prompt to call 911, instructions for the disposal of the device or the like).

Any of the medicament delivery devices shown and described herein can include any of the electronic circuit systems shown and described herein. For example, although the medical injector **5000** is shown as being devoid of an electronic circuit system, in other embodiments, the medical injector **5000** can include an electronic circuit system similar to the electronic circuit system **3900** shown and described above with reference to FIGS. **29-39**. Moreover, although the electronic circuit systems (e.g., the electronic circuit system **3900**) are shown and described herein as being coupled the housing of the medicament delivery device, in other embodiments, all or a portion of an electronic circuit system can be coupled to a removable cover (e.g., cover **3190**). For example, in some embodiments, the cover can include an electronic circuit system (the "master ECS") including an audible output device, and the electronic circuit system can be configured to receive on or more signals from an electronic circuit system (the "slave ECS") coupled to the medicament delivery device. In this manner, the master ECS can receive indications of when the safety tab has been removed, when the device has been actuated or the like, and can produce an audible output as described herein. In some such embodiments, the master ECS and the slave ECS can be similar to the electronic circuit systems shown and described in U.S. Patent Publication No. 2007/0129708, entitled "Devices, Systems and Methods for Medicament Delivery," filed on Feb. 5, 2007, which is incorporated herein by reference in its entirety.

Although the electronic circuit system **3900** is shown and described above as producing an electronic output in response to the removal of the safety lock **3700** and/or movement of the base **3510**, in other embodiments, any suitable component within a medicament delivery device can function to actuate the electronic circuit system. For example, in some embodiments, a carrier (similar to the carrier **3370**) can include a protrusion configured to engage a portion of an electronic circuit system such that the electronic circuit system produces an output in response to movement of the carrier. In other embodiments, an electronic circuit system can produce an electronic output in response to the deformation of a portion of a movable member (e.g., the engagement portion **3379** of the carrier **3370**). In such embodiments, the deformable portion may be configured to engage a portion of the electronic circuit system or may be configured such that a portion of the electronic circuit system is disposed therein (e.g., a copper trace) to activate the electronic circuit system.

In some embodiments, the electronic circuit system **3900** of the types shown and described herein can be used in either an actual medicament delivery device or a simulated medicament delivery device. A simulated medicament delivery device can, for example, correspond to an actual medicament delivery device and can be used, for example, to train a user in the operation of the corresponding actual medicament delivery device.

The simulated medicament delivery device can simulate the actual medicament delivery device in any number of ways. For example, in some embodiments, the simulated medicament delivery device can have a shape corresponding to a shape of the actual medicament delivery device, a size corresponding to a size of the actual medicament delivery device and/or a weight corresponding to a weight of the actual medicament delivery device. Moreover, in some embodiments, the simulated medicament delivery device can include components that correspond to the components of the actual medicament delivery device. In this manner, the simulated medicament delivery device can simulate the look, feel and sounds of the actual medicament delivery device. For example, in some embodiments, the simulated medicament delivery device can include external components (e.g., a housing, a needle guard, a sterile cover, a safety lock or the like) that correspond to external components of the actual medicament delivery device. In some embodiments, the simulated medicament delivery device can include internal components (e.g., an actuation mechanism, a compressed gas source, a medicament container or the like) that correspond to internal components of the actual medicament delivery device.

In some embodiments, however, the simulated medicament delivery device can be devoid of a medicament and/or those components that cause the medicament to be delivered (e.g., a needle, a nozzle or the like). In this manner, the simulated medicament delivery device can be used to train a user in the use of the actual medicament delivery device without exposing the user to a needle and/or a medicament. Moreover, the simulated medicament delivery device can have features to identify it as a training device to prevent a user from mistakenly believing that the simulated medicament delivery device can be used to deliver a medicament. For example, in some embodiments, the simulated medicament delivery device can be of a different color than a corresponding actual medicament delivery device. Similarly, in some embodiments, the simulated medicament delivery device can include a label clearly identifying it as a training device.

Although various embodiments have been described as having particular features and/or combinations of components, other embodiments are possible having a combination of any features and/or components from any of embodiments where appropriate. For example, any of the devices shown and described herein can include an electronic circuit system as described herein. For example, although the medicament delivery device **4000** shown in FIGS. **56** and **57** is not shown as including an electronic circuit system, in other embodiments, a medicament delivery device similar to the device **4000** can include an electronic circuit system similar to the electronic circuit system **3900** shown and described above.

Any of the medicament containers described herein can include any of the elastomeric members described herein. For example, the medicament container **5200** can include an elastomeric member **5217** that is formulated to be compatible with the medicament contained therein. Although the medical injector **5000** includes a single elastomeric member **5217**, in other embodiments, any number of elastomeric members **5217** can be disposed within the medicament container **5200**. For example, in some embodiments, a medicament container can include a dry portion of a medicament and a fluid portion of the medicament, configured to be mixed before injection. The piston portion **5330** of the medicament delivery mechanism **5300** can be configured to engage multiple elastomeric

members **5217** associated with the portions of the medicament. In this manner, multiple elastomeric members **5217** can be engaged to mix the dry portion with the fluid portion of the medicament before the completion of an injection event. In some embodiments, for example, any of the devices shown and described herein can include a mixing actuator similar to the mixing actuators shown and described in U.S. Patent Application US 306456-2142, entitled "Devices and Methods for Delivering Medicaments from a Multi-Chamber Container," filed on the same date herewith, which is incorporated herein by reference in its entirety.

What is claimed is:

1. An apparatus, comprising:

a housing;

a medicament container configured to move within the housing between a first position and a second position in response to a force produced by an energy storage member, a proximal end portion of the medicament container including a flange and having a plunger disposed therein; and

a movable member configured to move within the housing, the movable member being monolithically constructed and including a first shoulder, a second shoulder, and a retraction spring, the first shoulder of the movable member configured to exert at least a portion of the force on a proximal surface of the flange to move the medicament container from the first position to the second position, a portion of the first shoulder configured to deform when the medicament container is in the second position such that (1) the first shoulder is at least partially disposed in the medicament container and (2) the portion of the force is exerted upon the plunger, the second shoulder of the movable member configured to exert a retraction force produced by the retraction spring on a distal surface of the flange to move the medicament container from the second position towards the first position.

2. The apparatus of claim **1**, further comprising:

a damping member disposed between the first shoulder of the movable member and the flange of the medicament container.

3. The apparatus of claim **1**, further comprising:

a damping member disposed between the second shoulder of the movable member and the flange of the medicament container.

4. The apparatus of claim **1**, wherein the medicament container is configured to move from the first position to the second position in a first direction, the retraction spring configured to produce the retraction force to move the movable member in a second direction.

5. The apparatus of claim **1**, further comprising:

the energy storage member, the energy storage member being any one of a spring, a container configured to produce a pressurized gas or a device configured to store electrical energy.

6. The apparatus of claim **1**, wherein the movable member includes a piston portion disposed within the medicament container, the piston portion spaced apart from the plunger when the medicament container is in the first position, the piston portion configured to move with the medicament container when the medicament container moves from the first position to the second position, the piston portion configured to move relative to the medicament container to contact the plunger such that a medicament is expelled from the medicament container after the portion of the first shoulder is deformed.

7. The apparatus of claim **1**, further comprising:

a piston coupled to the movable member, at least a portion of the piston disposed within the medicament container, the portion of the piston disposed apart from the plunger when the medicament container is in the first position, the portion of the piston in contact with the plunger after the portion of the first shoulder is deformed.

8. The apparatus of claim **1**, wherein the movable member is a first movable member, the apparatus further comprising:

a second movable member configured to move with the medicament container when the medicament container moves from the first position to the second position, the second movable member configured to move relative to the medicament container to expel a medicament from the medicament container after the portion of the first shoulder is deformed.

9. The apparatus of claim **1**, wherein the movable member is configured to move with the medicament container when the medicament container moves from the first position to the second position, the movable member configured to move relative to the medicament container to expel a medicament from the medicament container after the portion of the first shoulder is deformed.

10. The apparatus of claim **1**, wherein the medicament container is a prefilled syringe containing at least one of influenza A vaccine, influenza B vaccine, influenza A (H1N1) vaccine, hepatitis A vaccine, hepatitis B vaccine, haemophilus influenza Type B (HiB) vaccine, measles vaccine, mumps vaccine, rubella vaccine, polio vaccine, human papilloma virus (HPV) vaccine, tetanus vaccine, diphtheria vaccine, pertussis vaccine, bubonic plague vaccine, yellow fever vaccine, cholera vaccine, malaria vaccine, smallpox vaccine, pneumococcal vaccine, rotavirus vaccine, varicella vaccine, rabies vaccine, meningococcus vaccine, epinephrine, salicylic acid, naloxone, naltrexone, buprenorphine, diazepam, lorazepam, midazolam, testosterone, vitamin D, vitamin B12, diphenhydramine, hydroxyzine, risperidone, haloperidol, hyaluronidase, sumatriptan, methotrexate, insulin, glucagon, exenatide, C1 esterase inhibitor, kallikrein inhibitor, bradykinin B2 inhibitor, human growth hormone (HGH), erythropoietin alfa/epoetin alfa, imiglucerase, darbepoetin alfa, denosumab, golimumab, adalimumab, certolizumab, ustekinumab, canakinumab, interferons (interferon-alpha-2a, interferon-alpha-2b, interferon-beta 1a, interferon-beta-1b, and their pegylated forms) etanercept, pegfilgrastim, enoxaparin, semuloparin, or dalteparin.

11. The apparatus of claim **1**, wherein a distal end portion of the medicament container is coupled to a needle, the needle disposed within the housing when the medicament container is in the first position, at least a portion of the needle is disposed outside of the housing when the medicament container is in the second position, the retraction force exerted by the second shoulder of the movable member on the flange of the medicament container being operable to retract at least a portion of the needle into the housing when the medicament container is moved towards the first position.

12. The apparatus of claim **1**, wherein:

the medicament container is configured to move from the first position to the second position in a first direction; and

the movable member includes a protrusion configured to engage a portion of the housing when the medicament container is in the first position to limit movement of the medicament container in a second direction.

13. The apparatus of claim **1**, wherein the movable member defines a recess, at least the portion of the first shoulder configured to be disposed in the recess when the medicament

container is in the second position such that the portion of the force is exerted upon the plunger.

14. The apparatus of claim **1**, wherein the movable member is a first movable member, the apparatus further comprising:

a second movable member configured to move with the medicament container when the medicament container moves from the first position to the second position, the second movable member configured to be disengaged from the first movable member after the medicament container is placed in the second position such that the retraction force exerted by the first movable member on the flange moves the medicament container from the second position towards the first position.

15. An apparatus, comprising:

a housing;

a medicament container configured to move within the housing between a first position and a second position in response to a force produced by an energy storage member, a proximal end portion of the medicament container including a flange and having a plunger disposed therein; and

a movable member configured to exert at least a portion of the force on the medicament container to move the medicament container from the first position to the second position, the movable member including a piston portion, an engagement portion, and a retraction portion, the piston portion including a piston surface and an outer surface, the outer surface defining a recess,

the engagement portion configured to be transitioned between a first configuration and a second configuration, the engagement portion being partially disposed outside of the recess defined by the outer surface of the piston portion when the engagement portion is in the first configuration to limit movement of the piston portion relative to the plunger when the medicament container moves from the first position to the second position such that the piston surface is spaced apart from the plunger, the engagement portion being disposed within the recess when the engagement portion is in the second configuration and the medicament container is in the second position to place the piston surface in contact with the plunger,

the retraction portion configured to produce a retraction force to move the movable member and the medicament container towards the first position.

16. The apparatus of claim **15**, wherein the movable member includes a first shoulder configured to exert the force on a proximal surface of the flange of the medicament container to move the medicament container from the first position to the second position, and a second shoulder configured to exert the retraction force on a distal surface of the flange to move the medicament container from the second position towards the first position.

17. The apparatus of claim **15**, further comprising:

a damping member disposed between the movable member and the flange of the medicament container.

18. The apparatus of claim **15**, wherein the force produced by the energy storage member moves the medicament container in a first direction, the retraction portion forming a retraction spring configured to produce the retraction force to move the movable member in a second direction.

19. The apparatus of claim **15**, wherein the movable member is a first movable member, the apparatus further comprising:

a second movable member configured to move with the medicament container when the medicament container moves from the first position to the second position, and configured to move relative to the medicament container to expel a medicament from the medicament container after the engagement portion of the movable member is deformed, the second movable member configured to be disengaged from the first movable member after the medicament is expelled from the medicament container.

20. The apparatus of claim **15**, wherein the movable member is a first movable member, the apparatus further comprising:

a second movable member configured to selectively engage the first movable member, the second movable member defining a longitudinal axis that is offset from a longitudinal axis of the first movable member.

21. An apparatus, comprising:

a housing;

a medicament container configured to move within the housing between a first position and a second position in response to a force produced by an energy storage member, a proximal end portion of the medicament container including a flange and having a plunger disposed therein;

a first movable member configured to move within the housing, the first movable member including a latch portion, a first shoulder and a second shoulder, the latch portion operably coupled to the energy storage member such that the first shoulder of the first movable member is configured to exert at least a portion of the force on the flange to move the medicament container from the first position to the second position, a portion of the first movable member configured to be at least partially disposed within the medicament container when the medicament container is in the second position such that at least a portion of the force is exerted upon the plunger to move the plunger within the medicament container, a second shoulder of the first movable member configured to exert a retraction force on the flange to move the medicament container from the second position toward the first position after the plunger is moved within the medicament container; and

a second movable member coupled to the energy storage member and selectively engaged with the latch portion of the first movable member, the second movable member configured to transfer the force produced by the energy storage member to the latch portion to move the first movable member such that the medicament container is moved from the first position to the second position, the second movable member configured to move the first movable member relative to the medicament container to move the plunger within the medicament container, the second movable member configured to be disengaged from the latch portion after the plunger is moved within the medicament container such that the retraction force exerted on the flange by the second shoulder moves the medicament container from when the second position toward the first position.

22. The apparatus of claim **21**, wherein:

the force produced by the energy storage member moves the medicament container in a first direction, and

the first movable member includes a retraction spring configured to produce the retraction force to move the movable member in a second direction.

23. The apparatus of claim **21**, wherein the first movable member is monolithically constructed and includes a retraction spring configured to produce the retraction force.

24. The apparatus of claim **21**, wherein a longitudinal axis of the second movable member is offset from a longitudinal axis of the first movable member.

25. The apparatus of claim 21, wherein the second movable member is placed in contact with a protrusion of the housing when the medicament container is placed in the second position, the protrusion configured to deform a portion of the second movable member to disengage the second movable member from the latch portion of first movable member.

26. An apparatus, comprising:

a movable member configured to be disposed within a housing of a medical device, the movable member being monolithically constructed to include a first engagement portion, a second engagement portion, and a retraction portion, the first engagement portion configured to be operably coupled to an energy storage member,

the second engagement portion configured to engage a flange of a medicament container such that a first shoulder of the second engagement portion exerts a first force produced by the energy storage member on the flange to move the medicament container within the housing in a first direction from a first position to a second position, at least a portion of the movable member being moved within the medicament container when the medicament container is in the second position to expel a medicament from the medicament container,

the retraction portion configured to produce a second force, a second shoulder of the second engagement portion configured to exert the second force produced by the retraction member on the flange to move the medicament container within the housing in a second direction from the second position towards the first position.

27. The apparatus of claim 26, wherein the first engagement portion is configured to be releasably coupled to the energy storage member by a latch portion.

28. The apparatus of claim 27, wherein, the first engagement portion is configured to be disengaged from the energy storage member when the medicament container is in the second position.

29. The apparatus of claim 26, wherein the first shoulder of the second engagement portion is configured deform to allow the portion of the movable member to be moved within the medicament container.

30. The apparatus of claim 26, wherein the retraction portion forms a spring.

31. The apparatus of claim 26, the second engagement portion is configured to deform when the medicament container is in the second position such that a piston surface of the movable member is placed in contact with a plunger disposed in the medicament container to move the plunger within the medicament container.

32. An apparatus, comprising:

a housing;

a medicament container configured to move within the housing between a first position and a second position in response to a force produced by an energy storage member, a proximal end portion of the medicament container including a flange and having a plunger disposed therein; and

a movable member including a piston portion having a first surface, a second surface, a first engagement portion, and a second engagement portion, the first engagement portion extending from the first surface and configured to be transitioned between a first configuration and a second configuration, the first engagement portion in contact with a proximal surface of the flange of the medicament container when in the first configuration to maintain a distance between the second surface of the piston portion and the plunger as the medicament container is moved from the first position to the second position, the first engagement portion configured to be transitioned from the first configuration to the second configuration when the medicament container is in the second position such that the first engagement portion is disposed in a recess defined by the first surface of the piston portion, the second surface of the piston portion configured to be placed in contact with the plunger when the first engagement portion is in the second configuration, the second engagement portion configured to exert a retraction force on a distal surface of the flange to move the medicament container from the second position towards the first position after the piston portion moves the plunger within the medicament container.

33. The apparatus of claim 32, wherein the piston portion is at least partially disposed in the medicament container and is movable within the medicament container between a first piston position and a second piston position, the first engagement portion disposed in the recess when in the second configuration such that the first engagement portion and the recess are disposed in the medicament container when the piston portion is in the second position.

34. The apparatus of claim 32, wherein the first engagement portion is configured to exert at least a portion of the force produced by the energy storage member on the flange to move the medicament container from the first position to the second position.

35. The apparatus of claim 32, wherein the movable member includes a third engagement portion, the third engagement portion releasably coupled to the energy storage member, the third engagement portion configured to be disengaged from the energy storage member when the medicament container is in the second position.

36. The apparatus of claim 32, wherein the first engagement portion is configured to be plastically deformed when transitioned from the first configuration to the second configuration.

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